Chapter 6 - Environmental Monitoring Program (Groundwater and Surface Water)

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Chapter Highlights

One potential pathway for exposure from contaminants released at the Idaho National Environmental and Engineering Laboratory (INEEL) is through the water pathway (surface water, drinking water, and groundwater). The Management and Operating contractor monitors groundwater, as well as liquid effluents, drinking water, and storm water runoff at the INEEL to comply with applicable laws and regulations, DOE orders, and other requirements (e.g., Wastewater Land Application Permit requirements). Argonne National Laboratory-West and the Naval Reactors Facility conduct their own groundwater, effluent, and drinking water monitoring. The U.S. Geological Survey (USGS) INEEL Project Office performs groundwater monitoring, analyses, and studies of the Snake River Plain Aquifer (SRPA) under and adjacent to the INEEL. The Environmental Surveillance, Education and Research contractor monitors drinking water and surface water at offsite locations.

Historic waste disposal practices have produced localized areas of chemical and radiochemical contamination in the SRPA beneath the INEEL. These contaminated areas are monitored by various organizations.

Results from a number of special studies conducted by the USGS of the properties of the aquifer and the water within it were published during 2003. Several purgeable organic compounds continue to be found in monitoring wells, including drinking water wells at the INEEL. Concentrations of organic compounds were below the U.S. Environmental Protection Agency maximum contaminant levels and state of Idaho groundwater primary and secondary concentration standards for these constituents.

Groundwater surveillance monitoring required in area specific Records of Decisions under the *Comprehensive Environmental Response, Compensation, and Liability Act* were performed in 2003. No contaminant concentrations exceeded expected or historical concentrations.

A total of 12 offsite surface water samples were collected from five locations along the Snake River. Nine of the samples had measurable gross beta activity, while only one sample had measurable tritium. Detectable gross alpha activity was found at only one location in the initial sample. None of these constituents were above regulatory limits.

6. ENVIRONMENTAL MONITORING PROGRAMS (GROUNDWATER AND SURFACE WATER)

Operations at facilities located on the Idaho National Engineering and Environmental Laboratory (INEEL) release radioactive and nonradioactive constituents into the environment. These releases are in compliance with regulations, and monitoring of the releases ensures protection of the public and environment. Historic waste disposal practices have produced localized areas of chemical and radiochemical contamination in the Snake River Plain Aquifer (SRPA) beneath the INEEL. These contaminated areas are monitored by various organizations.

This chapter presents results from both radiological and nonradiological surveillance sampling and *Comprehensive Environmental, Response, Compensation, and Liability Act* (CERCLA) sampling of groundwater and surface water samples taken at both onsite and offsite locations. Results from sampling conducted by the Management and Operating (M&O) contractor; Argonne National Laboratory-West (ANL-W); the U.S. Geological Survey (USGS); and the Environmental Surveillance, Education and Research Program (ESER) contractor are presented here. Results are compared to the state of Idaho groundwater primary and secondary constituents standards (PCS/SCS) of IDAPA 58.01.11 (IDAPA 58.01.11) and the U.S. Environmental Protection Agency (EPA) health-based maximum contaminant levels (MCL) for drinking water and/or the U.S. Department of Energy (DOE) Derived Concentration Guide (DCG) for ingestion of water.

This chapter begins with a general overview of the various organizations monitoring groundwater at the INEEL in Section 6.1. Section 6.4 describes aquifer studies related to they INEEL and SRPA. Sections 6.2 and 6.3 present discussions of the hydrogeology of the INEEL and hydrogeologic data management, respectively. Radiological and nonradiological monitoring of groundwater at the INEEL are discussed in Sections 6.5 and 6.6, respectively. Section 6.7 outlines the CERCLA groundwater activities performed in 2003. Section 6.8 describes surface water monitoring.

6.1 Summary of Monitoring Programs

The USGS INEEL Project Office performs groundwater monitoring, analyses, and studies of the SRPA under and adjacent to the INEEL. This is done through an extensive network of strategically placed observation wells on the INEEL (Figures 6-1 and 6-2) and at locations throughout the Eastern Snake River Plain (ESRP). Chapter 3, Section 3.1, summarizes the USGS routine groundwater surveillance program. In 2003, USGS personnel collected 1324 samples for radionuclides and inorganic constituents including trace elements and 28 samples for purgeable organic compounds.

In addition to the above duties, the USGS performs groundwater monitoring activities for the Naval Reactors Facility (NRF) through an interagency agreement. As part of the 2003 NRF sampling program, the USGS performed sampling three times from nine NRF wells and four USGS wells, collecting a total of 45 samples. Samples were analyzed for radionuclides, inorganic constituents, and purgeable organic compounds.

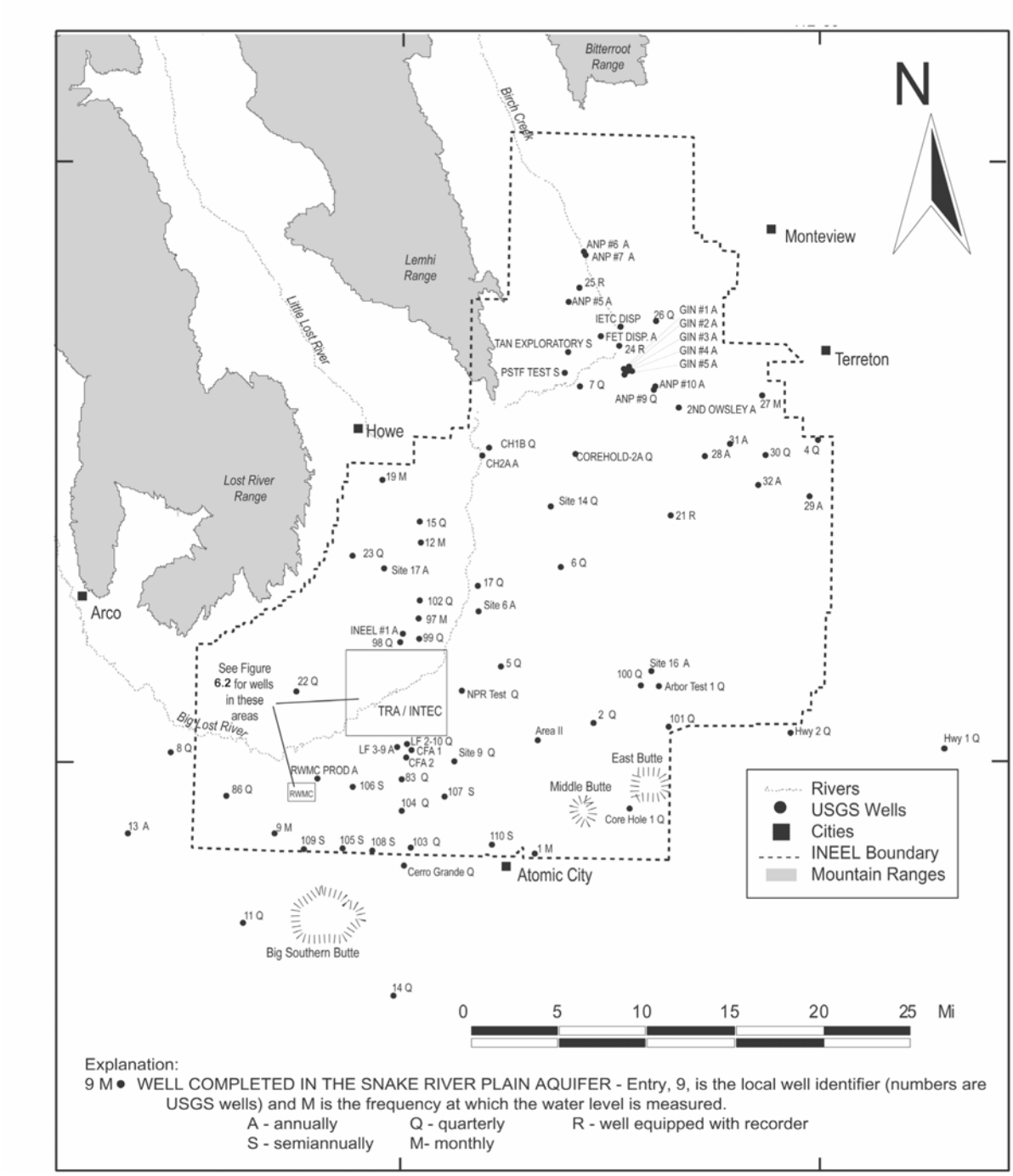

Figure 6-1. USGS well locations (Bartholomay et al. 2000).

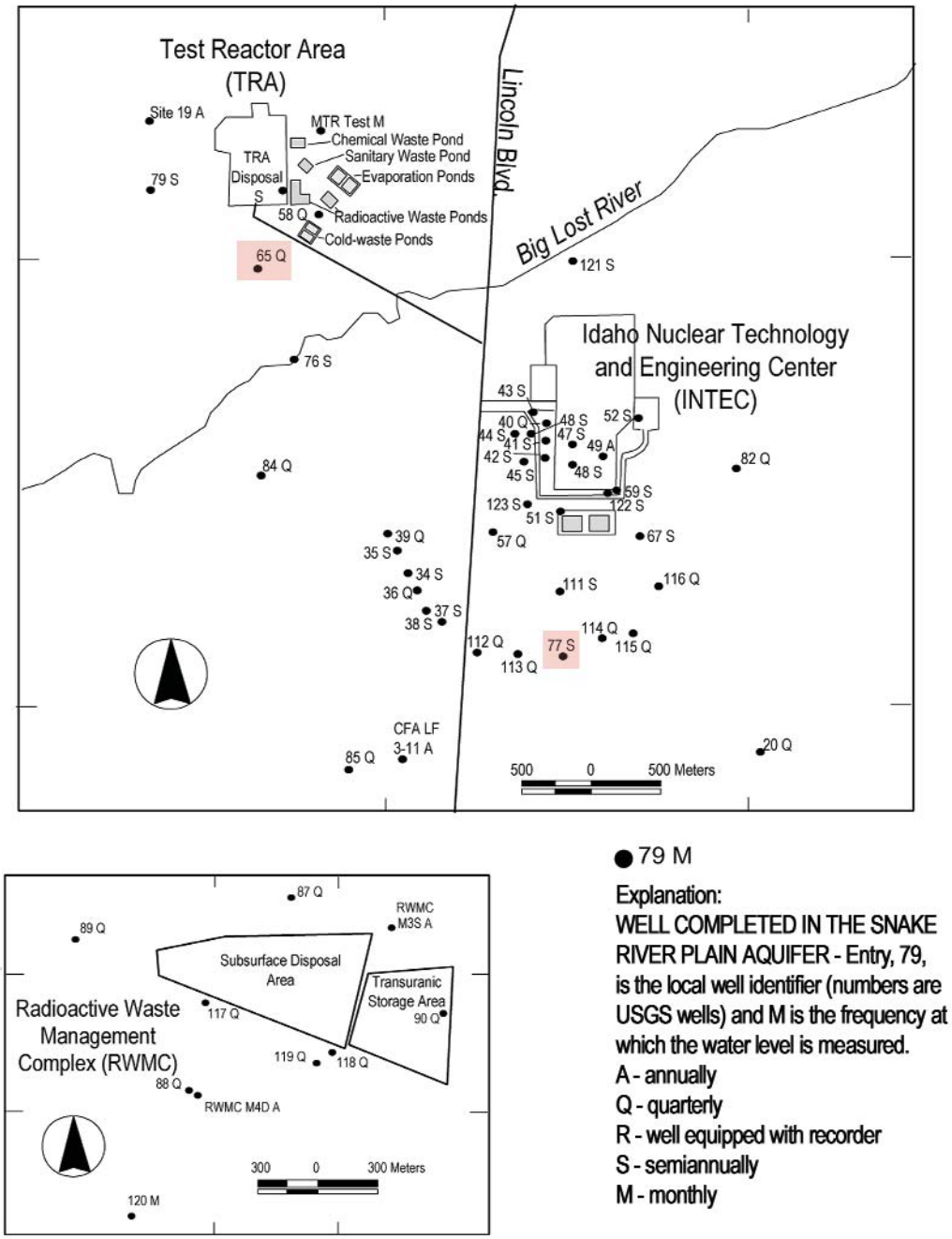

Figure 6-2. USGS well locations at the Idaho Nuclear Technology and Engineering Center, Test Reactor Area, and Radioactive Waste Management Complex (Bartholomay et al. 2000).

ANL-W performs semiannual groundwater monitoring at one upgradient monitoring well, three downgradient monitoring wells, and one production well. Samples are analyzed for gross activity (alpha and beta), uranium isotopes, tritium, inorganics, and water quality parameters.

As detailed in Chapter 3, CERCLA activities at the INEEL are divided into ten Waste Area Groups (WAGs) (Figure 3-3). Each of these WAGs is addressing groundwater for its particular

contaminants. WAG 10 has been designated as the site-wide WAG and addresses the combined impact of the individual contaminant plumes. As individual Records of Decision (RODs) are approved for each WAG, many of the groundwater monitoring activities are administratively turned over to the Long-Term Stewardship (LTS) program as an effort to consolidate monitoring activities.

The ESER contractor monitors surface water at offsite locations and collected 12 water samples for analyses in 2003.

The INEEL Oversight Program collects split samples with the M&O and other INEEL contractors of groundwater from both compliance (discussed in Chapter 5) and surveillance wells. Results of the Oversight programs monitoring are presented in annual reports prepared by that organization and are not reported here.

Table 6-1 presents the various groundwater and surface water monitoring activities performed on and around the INEEL.

6.2 Hydrogeology

The INEEL occupies 2300 km^2 (890 $mi^{2)}$ of the northwest side of the ESRP. The ESRP is a northeast-southwest oriented structural basin approximately 435 km (270 miles) long and 80 to 113 km (50 to 70 miles) wide. The ESRP is bounded by typical Basin and Range fault block mountains and valleys along the north edge and downwarping and faulting along the southern edge. Over time, the ESRP has been filled with basaltic and rhyolitic volcanic rocks related to the passage of the North American tectonic plate over the Yellowstone hotspot.

Sequences of basaltic rocks make up approximately the upper 91 m (299 ft) of the fill material within the ESRP. Basalts were erupted over well defined cycles separated by long periods of no volcanic activity. Individual basalt flows range from 1.5 to 15 m (5 to 50 ft) in thickness and can cover tens of square miles. As newer basalt flows were erupted, they spread out across the landscape, covering previous basalt surfaces or accumulated soils to form interflow zones and interbeds, respectively. Moving through these interflow zones is the water of the SRPA.

The SRPA is one of the largest, most productive aquifers in the United States. It has been estimated that there are 200 to 300 million acre-feet of water contained within the SRPA. Presently, the aquifer is tapped to meet the demands of agriculture, industry, and the more than 280,000 people who live on and around the SRPA. In 1990, the SRPA was classified as a "sole-source aquifer" by the EPA. More recently the state of Idaho has implemented protections for the SRPA under its groundwater quality regulations.

The water of the SRPA originates as recharge from river waters of the upper Snake River Plain, such as the Henry's Fork, the south fork of the Snake River, and the Big and Little Lost Rivers. Other sources of recharge water include the flow of groundwater out of the surrounding mountain valleys (Birch Creek, Medicine Creek, Camas Creek), leakage from irrigation canals and ponds, and infiltration from precipitation and irrigation.

Table 6-1. Groundwater and surface water-related monitoring at the INEEL and surrounding area.

	Media			
Area/Facility[a]	Groundwater (Radiological)	Groundwater (Nonradiological)	Groundwater (CERCLA)	Surface Water
Argonne National Laboratory-West				
ANL-W	•	•		•[b]
Management and Operating Contractor				
CFA	•	•	•	•[b]
INTEC	•	•	•	•[b]
TRA	•	•	•	
TAN	•	•	•	•[b]
RWMC	•	•	•	•[b]
PBF/CITR				•[b]
IRC				
Naval Reactors Facility				
NRF	•	•		
Environmental Surveillance, Education and Research Program				
INEEL/Regional				•
U.S. Geological Survey				
INEEL/Regional	•	•		•[c]
INEEL Oversight Program				
INEEL/Regional	•	•	•	•

a. ANL-W = Argonne National Laboratory-West, CFA = Central Facilities Area, INTEC = Idaho Nuclear Technology and Engineering Center, TRA = Test Reactor Area, TAN = Test Area North, RWMC = Radioactive Waste Management Complex, PBF/CITR = Power Burst Facility/Critical Infrastructure Test Range, IRC = INEEL Research Center, and NRF = Naval Reactors Facility.

b. See Chapter 5 for details of surface water (liquid effluent and stormwater) monitoring.

c. Surface water samples are collected by the regional office of the USGS and are not discussed in this report.

Once in the SRPA, the water moves to the southwest at rates ranging from 1.5 to 6.1 m per day (5 to 20 ft per day). This is much faster than most aquifers and is attributed to the high porosity of the interflow zones.

Groundwater is removed from the SRPA through pumping for irrigation and as spring flows along the Snake River in the area between Twin Falls and Hagerman. Because of the high flow velocities, travel time from the INEEL to the Snake River through the SRPA varies from 50 to 100 years.

Beyond the regional controls on flow in the SRPA, the hydrogeology of the INEEL is controlled locally by surface water flows in the Big Lost River. Periods of high flow in the river have been shown to create temporary shifts in the local flow direction from northeast-southwest to north-south. The effect of these local changes has been to spread contamination related to INEEL operations over a larger area than would be expected. Other impacts of INEEL operations to the subsurface hydrogeology have been the formation of numerous perched water zones beneath waste ponds as a result of the seepage of pond water into the soils and the introduction of contaminants both directly (through injection) and indirectly (through vertical movement of water beneath ponds and facilities) to the SRPA.

6.3 Hydrogeologic Data Management

Over time, hydrogeologic data at the INEEL has been collected by a number of organizations, including the USGS, the Idaho Cleanup Project, the Environmental Monitoring Unit, and other site contractors. One of the functions of the INEEL Hydrogeologic Data Repository (HDR) is to maintain and make the data generated by these varied groups available, to users and researchers. The HDR was established as a central location for the storage and retrieval of hydrologic and geologic information at the INEEL. The HDR is used to maintain reports, data files, maps, historic records, subcontractor reports, engineering design files, letter reports, subsurface information, and other data in many formats. This information is related to the hydrology and geology of the INEEL, the ESRP, and the SRPA. The HDR is also used to maintain the INEEL Comprehensive Well Inventory, with records of well construction, modification, abandonment, and logging. The HDR also maintains databases of historic and current water analysis, water levels, and special studies. Information from the HDR is available by request. A web site is being constructed that will allow open access to much of this information.

In the same vein as the HDR, a single organization was created at the INEEL to handle all laboratory analytical requests. The INEEL Sample and Analysis Management (SAM) Program was established to provide, consolidated environmental sampling activities and analytical data management. The SAM provides a single point of contact for obtaining analytical laboratory services and managing cradle-to-grave analytical data records. The SAM develops statement(s) of work, procedures, and guidance documents to establish and maintain analytical and validation contracts. The consolidated approach is based on the need for Site-wide reporting compliance, comprehensive technical analyses, and increased consistency in the manner in which analytical data are managed at the INEEL. The SAM also participates in monitoring laboratory performance and annual onsite laboratory audits to ensure quality and compliance.

6.4 Aquifer Studies

The SRPA, which underlies the ESRP and the INEEL, serves as the primary source for drinking water and crop irrigation in the Upper Snake River Basin. A description of the hydrogeology of the INEEL and the movement of water in the SRPA is given in Section 6.2. Further information may be found in numerous publications of the USGS. Copies of these publications can be requested from the USGS INEEL Project Office by calling 208-526-2438. During 2003, the USGS published nine documents covering hydrogeologic conditions at the INEEL or on the Eastern Snake River Plain. The abstracts to each of these reports are presented in Appendix C.

6.5 Radiological Groundwater Monitoring

Historic waste disposal practices have produced localized areas of radiochemical contamination in the SRPA beneath the INEEL. The Idaho Nuclear Technology and Engineering Center (INTEC) facility used direct injection as a disposal method up to 1984. This wastewater contained high concentrations of both tritium and ^{90}Sr. Injection at the INTEC was discontinued in 1984 and the injection well sealed in 1990. When direct injection ceased, wastewater from INTEC was directed to a pair of shallow percolation ponds, where the water infiltrates into the subsurface. Disposal of low- and intermediate-level radioactive waste solutions to the percolation ponds ceased in 1993 with the installation of the Liquid Effluent Treatment and Disposal Facility. The old percolation ponds were taken out of service to be clean closed, and the new INTEC percolation ponds went into operation in August 2002. Test Reactor Area (TRA) also discharged contaminated wastewater to a shallow percolation pond. The TRA pond was replaced in 1993 by a flexible plastic (hypalon) lined evaporative pond, which stopped the input of tritium to groundwater.

The average combined rate of tritium wastewater disposal at the TRA and INTEC was highest between 1952 to 1983 (910 Ci/yr), decreased during 1984 to 1991 (280 Ci/yr), and continued to decrease during 1992 to 1995 (107 Ci/yr). From 1952 to 1998, the INEEL disposed about 93 Ci of ^{90}Sr at TRA and about 57 Ci at INTEC. Wastewater containing ^{90}Sr was never directly discharged to the SRPA at TRA; however, at INTEC a portion of the ^{90}Sr was injected directly to the SRPA. From 1996 to 1998, the INEEL disposed about 0.03 Ci of ^{90}Sr to the INTEC infiltration ponds (Bartholomay et. al. 2000).

Presently, only ^{90}Sr continues to be detected by the M&O contractor and the USGS at levels above the PCS value in some surveillance wells between INTEC and Central Facilities Area (CFA). Other radionuclides (i.e., gross alpha) have been detected above their PCS values in wells monitored by individual WAGs.

U.S. Geological Survey

Tritium - Because tritium is equivalent in chemical behavior to hydrogen, a key component of water, it has formed the largest plume of any of the radiochemical pollutants. The configuration and extent of the tritium contamination area, based on the most recent published data (1998), are shown in Figure 6-3 (Bartholomay et. al. 2000). The area of contamination

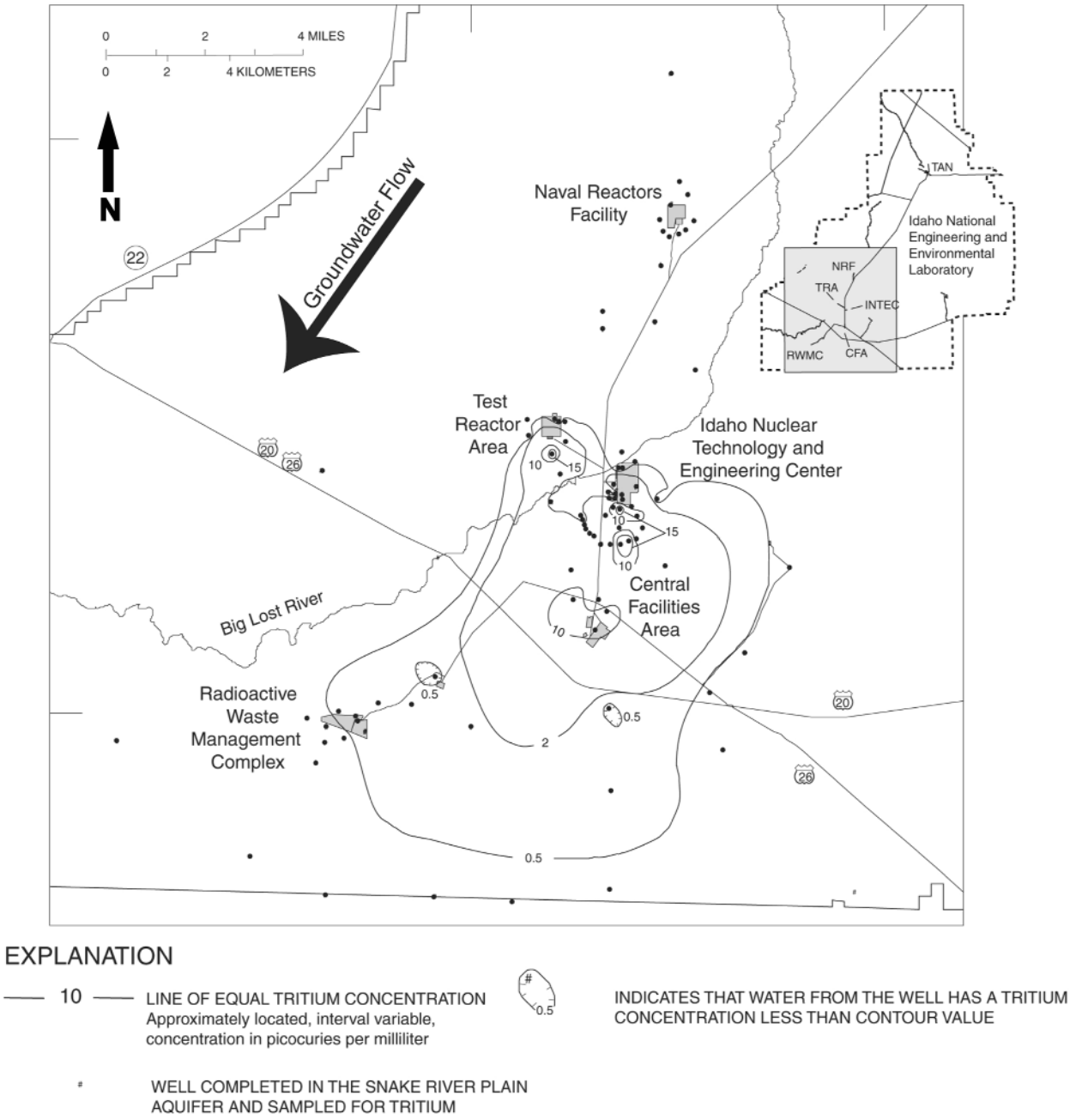

Figure 6-3. Distribution of tritium in the Snake River Plain Aquifer on the INEEL (1998) (Bartholomay et al. 2000).

within the 0.5 pCi/L contour line decreased from about 103 km^2 (40 mi^2) in 1991 to about 52 km^2 (approximately 20 mi^2) in 1998.

Concentrations of tritium in the area of contamination have continued to decrease. The area of elevated concentrations near CFA likely represents water originating at INTEC some years earlier when larger amounts of tritium were disposed. This is further supported by the fact that there are no known sources of tritium contamination to groundwater at CFA.

Two monitoring wells downgradient of TRA (Well 65) and INTEC (Well 77) (see Figure 6-2) have continually shown the highest tritium concentrations in the aquifer over time. For this reason, these two wells are considered representative of maximum concentration trends in the rest of the aquifer. The average tritium concentration in Well 65 near TRA decreased, from $(13.0 \pm 0.8) \times 10^3$ pCi/L in 2002 to $(9.4 \pm 0.05) \times 10^3$ pCi/L in 2003; the tritium concentration in Well 77 south of INTEC remained the same, $(13.8 \pm 0.04) \times 10^3$ pCi/L in 2002 to $(13.4 \pm 0.03) \times 10^3$ pCi/L in 2003.

The Idaho groundwater PCS for tritium is the same as the EPA MCL for tritium in drinking water of 20,000 pCi/L. The values in both Well 65 and Well 77 dropped below this limit in 1997 as a result of radioactive decay (tritium has a half-life of 12.3 years), a decrease in tritium disposal rates, and dilution within the SRPA and continue to decrease tritium concentrations (See Figure 6-4).

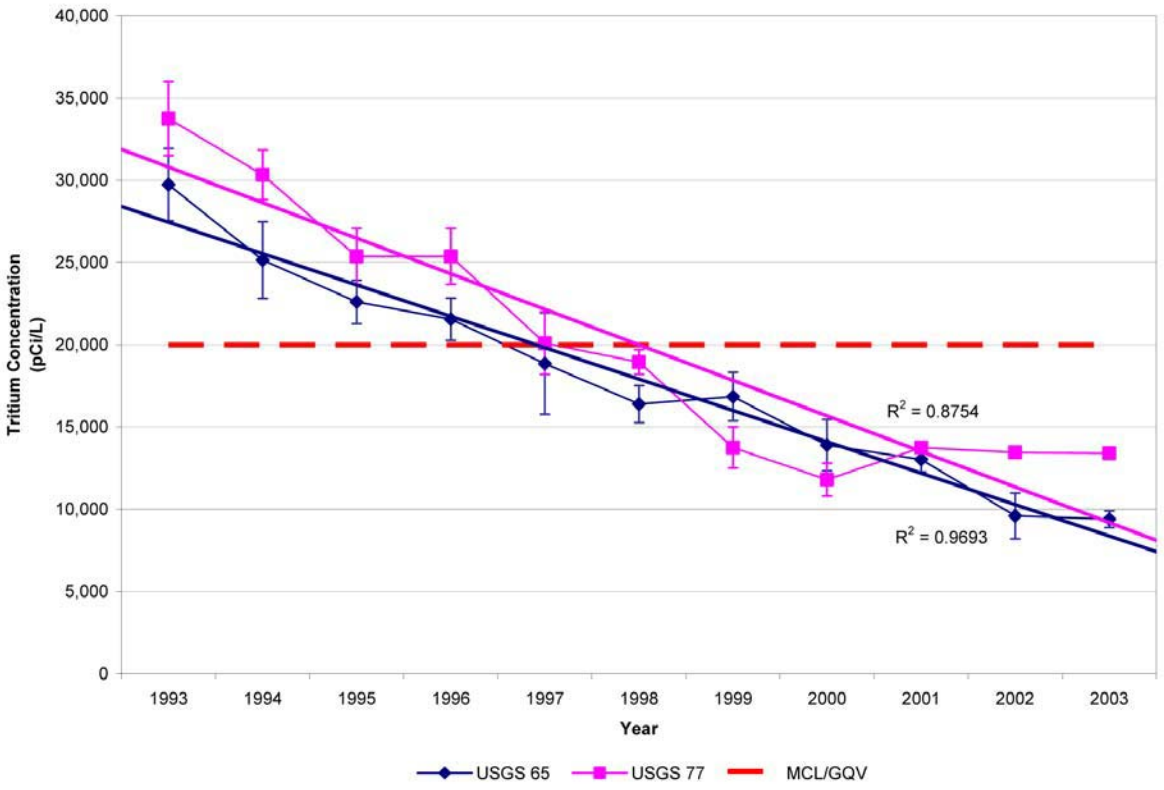

Figure 6-4. Long-term tend of tritium in USGS Well 65 and 77 (1993-2003). (Error bars are plus or minus one standard deviation [1s]).

Strontium-90 - The configuration and extent of ^{90}Sr in groundwater, based on the latest published USGS data, are shown in Figure 6-5 (Bartholomay et al. 2000). The contamination originates from INTEC as a remnant of the earlier injection of wastewater. No ^{90}Sr in groundwater has been detected in the vicinity of TRA. All ^{90}Sr at TRA was disposed to infiltration ponds in contrast to the direct injection that occurred at the INTEC. At TRA, ^{90}Sr is retained in surficial sedimentary deposits, interbeds, and in the perched groundwater zones. The area of the ^{90}Sr contamination from INTEC is approximately the same as it was in 1991.

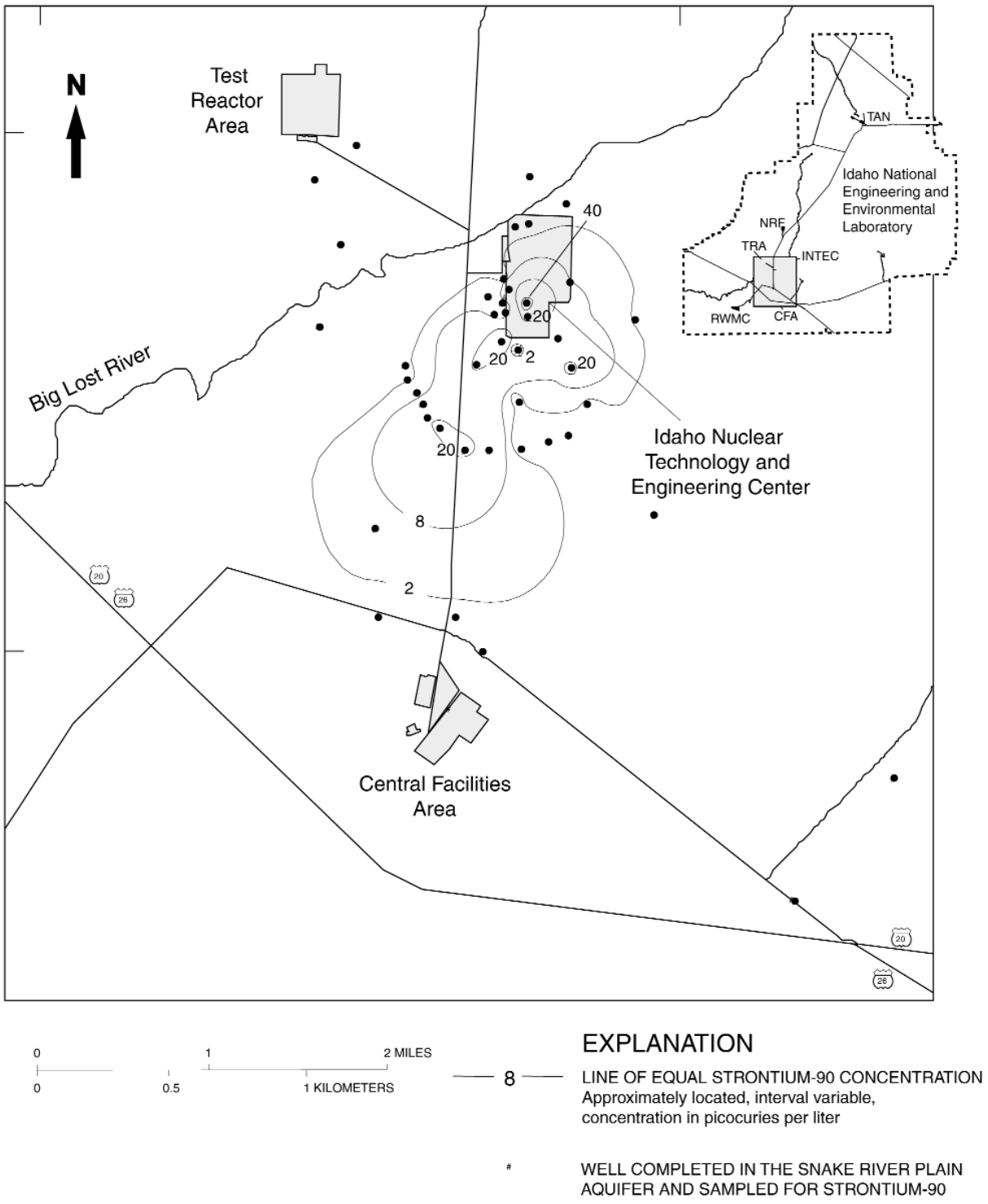

Figure 6-5. Distribution of ^{90}Sr in the Snake River Plain Aquifer on the INEEL (1998) (Bartholomay et al. 2000).

Mean concentrations of ^{90}Sr in wells have remained at about the same concentrations since 1989. The annual average concentration in well 65 increased between 2002 (1.5 ± 0.1 pCi/L) and 2003 (2.55 ± 0.58 pCi/L). Concentrations in Well 77 decreased from 2.0 ± 0.1 pCi/L in 2002 to 1.8 ± 0.7 pCi/L in 2003. The PCS and MCL for ^{90}Sr in drinking water is 8 pCi/L. The increase in ^{90}Sr in 2003 is the result of averaging a small sample set (two samples) and a single large result (3.4 ± 1.4 pCi/L). The other result was essentially the same as 2002 (1.7 ± 1.4 pCi/L).

The trend of ^{90}Sr over the past ten years is shown in Figure 6-6. Although the trend is increasing, the statistical fit is less strong (36 percent for Well 65 and 21 percent for Well 77). The uncertainties associated with ^{90}Sr are also larger. This increase over the last five years is thought to be due, in part, to a lack of recharge from the Big Lost River that would act to dilute the ^{90}Sr. Other reasons may also include an increase in the disposal of other chemicals into the INTEC percolation ponds that may have changed the affinity of ^{90}Sr on soil and rock surfaces, causing it to become more mobile (Bartholomay et. al. 2000).

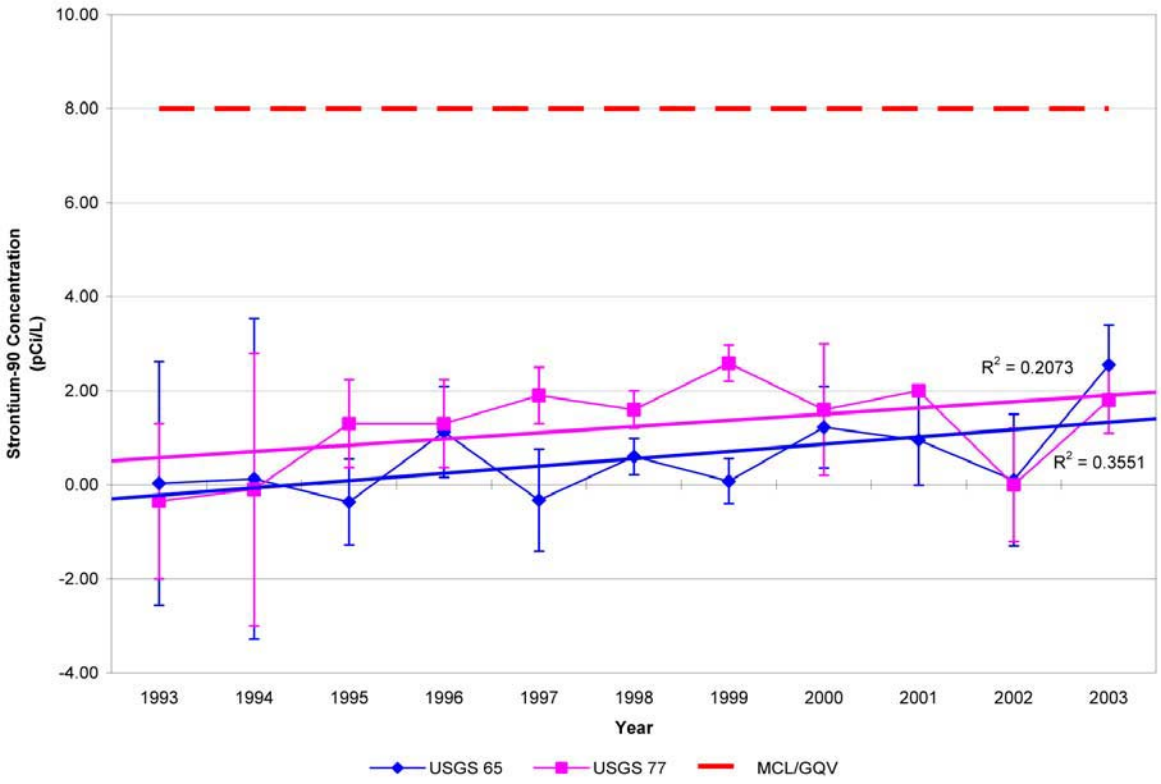

Figure 6-6. Long-term trend of ^{90}Sr in USGS Wells 65 and 77 (1993-2003).

Naval Reactors Facility

Groundwater samples around NRF are collected by the USGS under an interagency agreement. Groundwater monitoring did not detect any gross alpha or gross beta activity in excess of natural background concentrations. Measurements of tritium were at least a factor of 100 below MCL values. No ^{90}Sr or programmatic gamma-emitters were detected. For more information, see the *2003 Environmental Monitoring Report for the Naval Reactors Facility* (Bechtel Bettis 2003).

6.6 Nonradiological Groundwater Monitoring

U.S. Geological Survey

Sampling for purgeable (volatile) organic compounds in groundwater was conducted by the USGS at the INEEL during 2003. Water samples from an onsite production well and seven groundwater monitoring wells were collected and submitted to the USGS National Water Quality Laboratory in Lakewood, Colorado, for analysis of 28 purgeable organic compounds. USGS reports describe the methods used to collect the water samples and ensure sampling and analytical quality (Mann 1996, Bartholomay et al. 2003). Nine purgeable organic compounds were detected at concentrations above the laboratory reporting level of 0.2 or 0.1 µg/L in at least one well on the INEEL (Table 6-2). Only two of the constituents measured were reported in 2002, while four others are closely related to compounds reported in 2002. Three new methane-containing compounds were measured in 2003, tribromomethane, trichloromethane, and tetrachloromethane. None of the measured constituents were above their respective PCS.

The Radioactive Waste Management Complex (RWMC) production well contained detectable concentrations of six of these purgeable organic compounds. Annual average concentrations of these compounds in this well remained essentially unchanged from those observed in 2002. However, the annual average concentration for trichloroethene (2.48 µg/L) was slightly above the related compound trichloroethylene concentration of 2002 (2.32 µg/L).

Naval Reactors Facility

Groundwater samples around NRF are collected by the USGS under an interagency agreement. Most volatile organic compounds, inorganic analytes, and water quality parameters were below the minimum detection levels. All of the target nonradiological constituent concentrations averaged below Idaho PCS/SCS and EPA MCLs, with the exception of chromium in Well NRF-6. The high average value for chromium in NRF-6 is from a single outlier that appears to be an anomalous result. Groundwater monitoring wells are not used for drinking water supply. For more information, see the 2003 Environmental Monitoring Report for the Naval Reactors Facility (Bechtel Bettis 2003).

Table 6-2. Concentrations of purgeable organic compounds in USGS well samples (2003).[a]

Well ID	Date	Dichloro-difluoro-methane	1,1-Dichloro-ethene	Tetrachloro-ethene	Tetrachloro-methane	Toluene	Tribromo-methane	1,1,1-Trichloro-ethane	Trichloro-ethene	Trichloro-methane
34	04/16	ND[b]	ND	ND	ND	ND	ND[c]	ND	ND	ND
(SW of INTEC)	11/06	ND	ND	ND	ND	ND	ND	0.12	ND	ND
38	04/23	ND	ND	ND	ND	ND	ND	ND	ND	ND
(SW of INTEC)	11/13	0.1807[d]	ND	ND	ND	ND	ND	0.15	ND	ND
65	04/14	0.46[d]	ND	ND	ND	ND	ND	0.17	ND	ND
(S of TRA)	11/04	ND	0.11	ND	ND	1.6	ND	0.21	ND	ND
77	04/16	0.13[d]	0.15	ND	ND	ND	ND	0.20	ND	ND
(S of TRA)	11/03	0.12[d]	0.18	ND	ND	ND	ND	0.25	ND	ND
87	04/10	0.23[d]	ND	0.10	3.18	ND	ND	ND	0.69	0.17
(N of RWMC)	10/09	0.22[d]	ND	0.11	3.29	ND	ND	ND	0.69	0.14
88	04/02	ND	ND	ND	1.58	ND	ND	0.12	0.63	0.45
(S of RWMC)										
120	04/10	ND	ND	ND	3.01	ND	ND	0.24	0.87	0.51
(SW of RWMC)	10/09	ND	ND	0.11	3.03	ND	ND	0.25	0.88	0.45

Table 6-2. Concentrations of purgeable organic compounds in USGS well samples (2003).[a] (continued)

Well ID	Date	Dichloro-difluoro-methane	1,1-Dichloro-ethene	Tetrachloro-ethene	Tetrachloro-methane	Toluene	Tribromo-methane	1,1,1-Trichloro-ethane	Trichloro-ethene	Trichloro-methane
RWMC PROD	01/09	ND	ND	0.22	5.77	ND	ND	0.54	2.42	1.27
	02/13	ND	ND	0.22	4.41	ND	ND	0.43	2.11	0.88
	03/13	ND	ND	0.18	5.14	ND	ND	0.44	2.28	0.91
	04/10	ND	ND	0.24	5.57	ND	ND	0.49	2.60	1.14
	05/15	ND	ND	0.25	5.52	ND	ND	0.50	2.66	1.15
	06/12	ND	ND	ND	5.65	ND	ND	0.46	2.41	1.09
	07/10	ND	ND	0.23	6.65	ND	ND	0.56	2.66	1.19
	08/14	ND	ND	0.26	6.33	ND	ND	0.53	2.85	1.29
	09/10	ND	ND	0.19	4.01	ND	0.22	0.37	1.78	0.81
	10/09	ND	ND	0.23	5.39	ND	ND	0.47	2.29	0.97
	11/13	ND	ND	0.23	6.02	ND	ND	0.52	2.64	1.19
	12/18	ND	ND	0.27	6.79	ND	ND	0.55	3.02	1.33
PCS[e]			**7.0[f]**	**5.0[g]**		**1,000**		**200**	**5[h]**	

a. All values are in micrograms per Liter (µg/L).
b. ND = Not Detected, below the reportable limit of 0.2 µg/L before 10/04 or 0.01 µg/L for 10/04 and later.
c. Not Detect value for tribromomethane is 0.2 µg/L for all samples.
d. Values for dichloro-difluoromethane are laboratory estimates.
e. PCS = Primary constituent standard values from IDAPA 58.01.11.
f. Value is for the related compound 1,1- dichloroethylene.
g. Value is for the related compound tetrachloroethylene.
h. Value is for the related compound trichloroethylene.

6.7 CERCLA Groundwater Monitoring Activities

The 2003 CERCLA activities at the INEEL included the drilling of five new wells at TAN (one corehole was completed as a piezometer), and the abandonment of three coreholes. The 192 aquifer monitoring wells were sampled to satisfy CERCLA requirements (Table 6-3). A detailed accounting of the sampling and results are available in the individual monitoring reports for each WAG. These data have been summarized in their respective sections below.

Table 6-3. Summary of groundwater monitoring wells sampled for CERCLA activities during 2003.

Waste Area Group	Frequency of Sampling	Constituents Analyzed	Number of Wells Sampled in 2003
WAG 1 – Test Area North	Annual	Rad[a], Inorganic[b], Organic[c]	40
WAG 2 – Test Reactor Area	Semi-annual	Rad, Inorganic	14
WAG 3 – Idaho Nuclear Technology and Engineering Center			
- Group 4 Perched Water	Annual	Rad, Inorganic, Organic	40
- Group 5 Snake River Plain Aquifer	Annual	Rad, Inorganic	22
- INEEL CERCLA Disposal Facility	Quarterly	Rad, Inorganic, Organic	8
WAG 4 – Central Facilities Area	Annual	Inorganic, Organic	10
WAG 5 – Power Burst Facility/ Auxiliary Reactor Area	Annual	Organic, Inorganic	9
WAG 7 – Radioactive Waste Management Complex	Quarterly	Rad, Inorganic, Organic	15
WAG 10 – Sitewide	Semiannual	Rad, Inorganic, Organic	34
	Total Number of Wells Monitored in 2003		**192**

a. Rad = radiological constituents, such as tritium, ^{90}Sr, ^{99}Tc, ^{137}Cs, uranium, and plutonium isotopes.
b. Inorganic = inorganic constituents, such as metals (cadmium, chromium) and anions (chloride, nitrate).
c. Organic = organic constituents, such as volatile organic compounds (carbon tetrachloride, trichloroethylene).

Summary of WAG 1 Groundwater Monitoring Results

The objective of the OU 1 07B remedial action is to contain and restore the contaminated groundwater at Test Area North (TAN) for public use. The groundwater at TAN is contaminated with trichloroethene (TCE), tetrachloroethene, and dichloroethene. To facilitate this remedial action, the contaminated groundwater was divided into three zones. The locations of wells used in the definition of each zone are shown in Figure 6-7. The boundaries of each zone of the plume were based on TCE concentrations. The three zones are defined as follows:

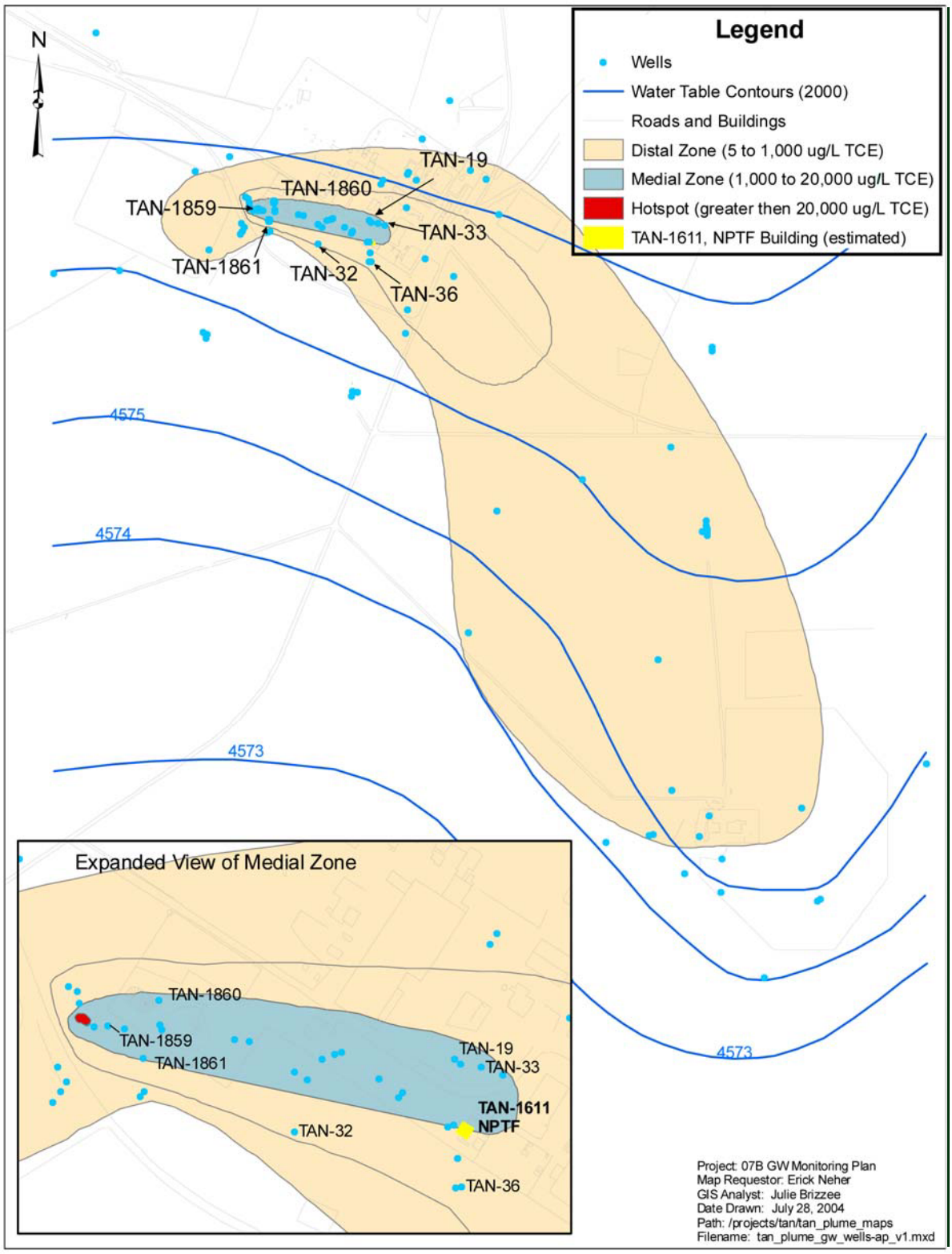

Figure 6-7. WAG 1 Well locations.

Hot Spot Zone (TCE concentrations exceeding 20,000 µg/L) - In situ bioremediation (ISB) is used in the hot spot to promote bacterial growth by supplying essential nutrients to bacteria that occur naturally in the aquifer and are able to break down contaminants. An amendment (such as sodium lactate or whey) is injected into well TSF-05 or other wells in the immediate vicinity. Amendment injections increase the rate at which the microbes break down the organic compounds into harmless compounds by supplying needed nutrients. The amendment supply is distributed, as needed, and the treatment system operates year-round.

In general, activities performed during 2003 included periodic amendment injections (sodium lactate), groundwater sampling and analysis, well-drilling activities, construction activities, and laboratory studies of alternate electron doners. Seven amendment injections were performed during the year, all into well TSF-05. Groundwater samples were collected monthly from 14 to 17 sampling locations in the hot spot zone. Three new wells were drilled during the reporting period, one amendment injection well (TAN-1859) and two cross-gradient monitoring wells (TAN-1860 and -1861). The new ISB injection facility also was completed during the reporting period. The completion of these activities allows the project to conclude Interim Operations and proceed into Initial Operations in accordance with the Remedial Action Work Plan (DOE-ID 2002).

Medial Zone (TCE concentrations between 1000 and 20,000 µg/L) - Pump-and-treat is used in the medial zone. This process involves extraction of contaminated groundwater, treatment through air strippers, and reinjection of treated groundwater. Air stripping is a process that brings clean air into close contact with contaminated liquid, allowing the volatile organic contaminants to pass from the liquid into the air.

During 2003, all contaminant concentrations in water and air effluents from the New Pump and Treat Facility (NPTF) were below discharge limits and the influent contaminant concentrations continued to decrease. Water levels in several monitoring wells responded to extraction well startup (that is, pumping from extraction wells caused drawdown at these monitoring wells). Drawdown in wells TAN-19, -32, -33, and -36 indicates that the required plume capture width is achieved and that the NPTF is meeting its operational requirement to keep contaminated groundwater from migrating further downgradient.

Distal Zone (TCE concentrations between 5 and 1000 µg/L) - Monitored natural attenuation (MNA) has been selected as the treatment of choice for the distal zone of the plume. This process is the sum of the physical, chemical, and biological processes that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater.

Engineering and administrative controls are in place to protect current and future users from health risks associated with groundwater contamination. During the early part of the restoration timeframe, the contaminant plume may continue to increase slowly in size until the natural attenuation process overtakes it.

The primary MNA activities performed during 2003 were groundwater sampling and data analysis. Groundwater samples were collected for volatile organic compounds and radiological parameters from 17 monitoring wells. Several of these locations were equipped with FLUTe™

systems and were sampled at multiple discrete depths below land surface. In addition, dissolved gas samples and enzyme probe samples were collected to provide evidence for the aerobic TCE biodegradation mechanism that has been hypothesized to be active in the distal zone at TAN.

TCE concentration data and other data related to TCE degradation indicate that MNA will meet the remedial action objectives for the distal zone of the plume. Indirect and direct evidence from 2003 groundwater monitoring confirm that the mechanism for aerobic TCE co-metabolic degradation is active in the aquifer. Radionuclide groundwater monitoring in 2003 indicates that the natural attenuation mechanisms, as defined in the MNA Remedial Action Work Plan for the radionuclides tritium, cesium-137 (^{137}Cs), ^{90}Sr, and uranium-234 (^{234}U), continue to be functional within the contaminant plume (DOE-ID 2003a). Groundwater monitoring in 2003 has shown no alarming increases in radionuclides, and future groundwater monitoring, as outlined in the MNA Operations, Monitoring, and Maintenance Plan, will be sufficient to track the progress of the MNA remedy for radionuclides at TAN OU 1-07B (DOE-ID 2003b).

Summary of WAG 2 Groundwater Monitoring Results

Groundwater samples are required under the WAG-2 Record of Decision (ROD) from aquifer wells TRA-06A, TRA-07, TRA-08, USGS-058, USGS-065, and Highway-3. The locations of these wells are shown in Figure 6-8, except the location of the Highway-3 Well, which is shown in Figure 6-1. These wells were sampled in March and October of 2003. In the March 2003 sampling event, aquifer well samples were analyzed for cadmium (filtered and unfiltered), chromium (filtered and unfiltered), and tritium (with the exception of Well Highway-3). Only chromium analysis was performed on samples from the Highway-3 Well. In the October 2003 sampling event, the wells were sampled for chromium (filtered and unfiltered), ^{90}Sr, tritium, gamma spectrometry, technetium-99 (^{99}Tc), and iodine-129 (^{129}I). The data for the March 2003 sampling are in the Annual Groundwater Monitoring Status Report for Waste Area Group 2 for Fiscal Year 2003 (DOE-ID 2003c) and the data for the October 2003 sampling is found in the 2004 annual report for WAG 2.

The data for the March 2003 sampling event are summarized in Table 6-4. Chromium was the only constituent detected above its PCS. Chromium concentrations in wells TRA-07 and USGS-065 were greater than the 100 µg/L PCS, with a maximum filtered concentration of 158 µg/L in TRA-07 (Figure 6-8). Except for the Highway-3 Well, chromium concentrations were above background at all other aquifer wells sampled in WAG-2. The concentrations of chromium are declining as predicted by the WAG-2 ROD model and are trending to decline below the PCS by 2012. Other than chromium, all other constituents were below PCS/SCS values.

Summary of WAG 3 Groundwater Monitoring Results

The Long Term Monitoring Plan (DOE-ID 2003d) called for sampling 18 aquifer wells in and around as well as to the south of INTEC and collecting three deep discrete samples between wellbore packers. Samples were collected from 16 of the 18 wells from April 13 to May 31, 2003. The deep packer sampling at three wells was conducted in July-August 2003. Groundwater samples were analyzed for tritium, ^{90}Sr, ^{129}I, ^{99}Tc, americium-241 (^{241}Am), neptunium-237 (^{237}Np), uranium isotopes, plutonium isotopes, gross alpha/beta activities, gamma spectrometry, and mercury.

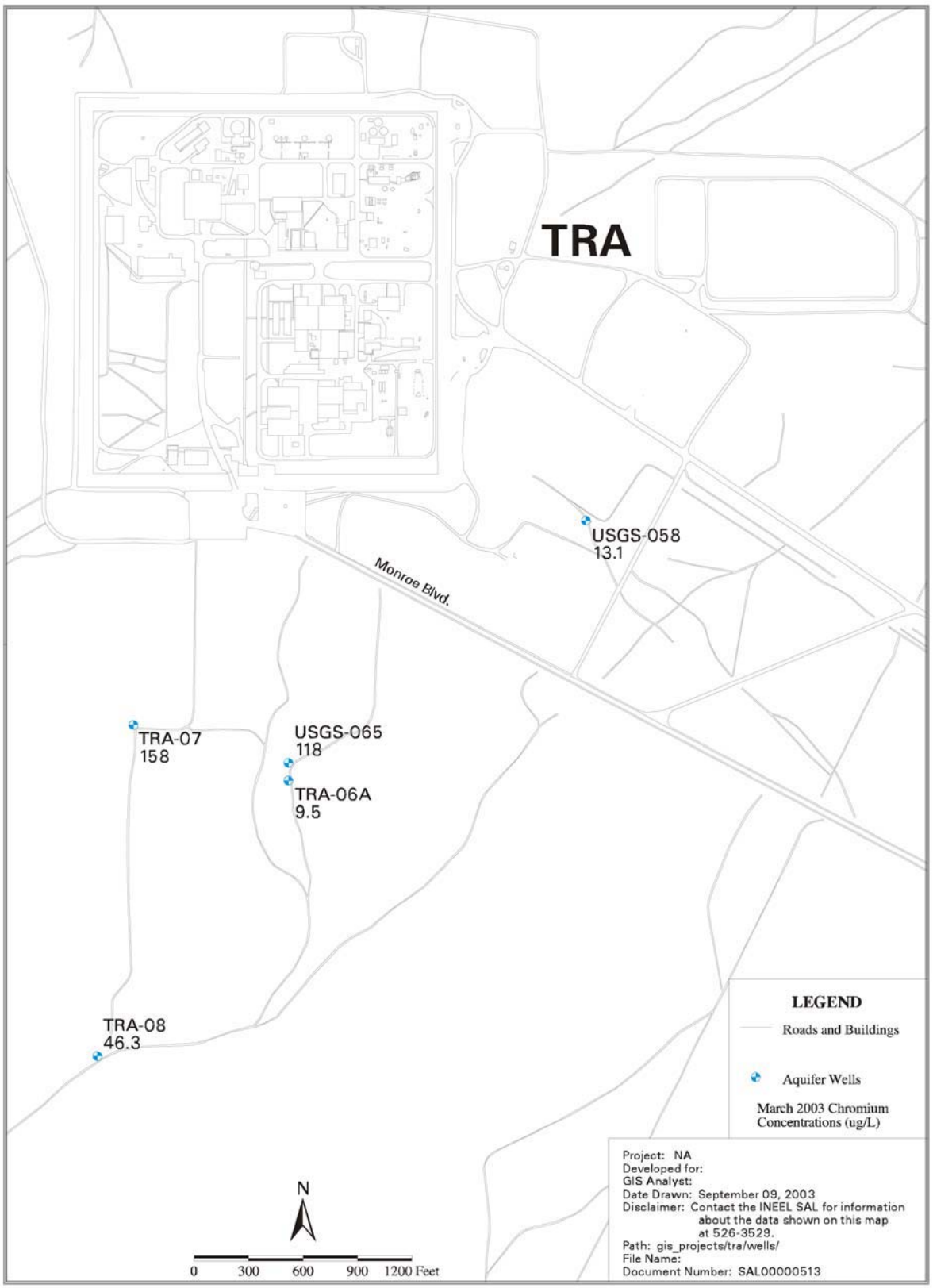

Figure 6-8. Location of TRA monitoring wells and March 2003 chromium concentrations.

Table 6-4. WAG 2 groundwater quality summary for March 2003 sampling event.[a]

Analyte	Background[b]	Maximum Concentration	Number of Wells with Detections above PCS[c]	PCS
Cadmium (Filtered)	<1	0.07	0	5
Cadmium (Unfiltered)		0.06	0	5
Chromium (Filtered)	2 to 3	159	2	100
Chromium (Unfiltered)		167	2	100
Tritium	75 to 150	16,700	0	20,000 pCi/L

a. All values are in micrograms per liter (μg/L) unless noted.
b. Background concentrations are from Knobel, Orr, and Cecil (1992).
c. PCS = primary constituent standard values from IDAPA 58.01.11.

Strontium-90, ^{99}Tc, and gross alpha were detected in some wells above their respective PCS values (DOE-ID 2003e). Tritium, ^{129}I, plutonium, uranium, and ^{137}Cs were also detected, but concentrations were below their PCS values. Uranium concentrations were at background levels in all wells. Cesium-137 was detected in three wells with a maximum concentration of 18.4 pCi/L, which is well below the MCL of 200 pCi/L. Plutonium-241 was detected at one location near the detection limit and was the only plutonium isotope detected.

The sampling results for gross alpha, gross beta, ^{90}Sr, ^{99}Tc, ^{129}I, and tritium are presented in Table 6-5. Strontium-90 was above its PCS and MCL of 8 pCi/L in several wells near INTEC, but was below its PCS in the downgradient direction in wells at the CFA landfills (Figure 6-9). Technetium-99 was detected above its MCL of 900 pCi/L in two wells (one within INTEC and one near CFA) but was below the MCL at all other locations. Gross beta results generally mirrored the results for ^{90}Sr and ^{99}Tc. Gross alpha was above its PCS in one well and at the PCS in another well within INTEC, but was below the PCS downgradient of INTEC.

Sampling and analysis results for 2003 confirm that concentrations of tritium, ^{129}I, and ^{90}Sr continue to decline in the SRPA at and downgradient of INTEC. In contrast, ^{99}Tc concentrations in the SRPA appear to have increased slightly at several locations, although lack of historical ^{99}Tc data makes this conclusion tenuous. The MCL for ^{99}Tc (900 pCi/L) was exceeded at one location, a new aquifer monitoring well ICPP-MON-A-230 located north of the INTEC tank farm.

Summary of WAG 4 Groundwater Monitoring Results

Groundwater monitoring for the CFA landfills consisted of sampling nine wells for volatile organic compounds, metals, and anions. The locations of the wells sampled are shown on Figure 6-10. Analytes detected in groundwater are compared to regulatory levels in Table 6-6. A full description of the groundwater sampling and results is contained in Central Facilities Area Landfills I, II, and III Annual Monitoring Report (2003) (DOE-ID 2004a). The groundwater data

Table 6-5. Summary of gross alpha, gross, beta, ^{129}I, ^{99}Tc, ^{90}Sr, and tritium in the SRPA at INTEC (WAG 3) in 2003.[a]

Location	Sampling Date	Gross Alpha (PCS[b]=15 pCi/L)		FLAG[c]	Gross Beta (PCS= 4mrem/yr)		FLAG	Iodine-129 (PCS=1 pCi/L)		FLAG	Technetium-99 (MCL=900 pCi/L)		FLAG	Strontium-90 (PCS=8 pCi/L)		FLAG	Tritium (PCS=20,000 pCi/L)		
		Result	+/-		Result	+/-		Result	+/-		Result	+/-		Result	+/-		Result	+/-	
ICPP-MON-A-230[d]	5/13/03	**32.7**[e]	2.72	J	931	19.1	J	0.12	0.03		**2,220**	37.7		7.61	1.05		3700	178	
LF2-08	5/28/03	0.06	0.35	UJ	-0.19	0.63	UJ	0.59	0.05		-4.50	2.43	U	-0.13	0.11	U	7740	285	
LF3-08	5/27/03	4.27	1.01	J	14.8	1.26	J	0.77	0.08		1970	34.6	R	7.05	0.89		6940	273	
MW-18	5/13/03	**15.0**	1.84	J	282	7.00	J	0.60	0.06		574	10.7		**23.5**	3.30		13700	324	
USGS-040	4/14/03	1.66	0.75	UJ	39.8	1.57	J	0.24	0.07	J	7.11	1.96	UJ	**16.4**	2.19		3230	143	
USGS-042	4/3/03	1.85	0.90	UJ	57.4	1.92	J	0.74	0.08	J	91.3	3.41		**15.5**	2.00		3360	148	
USGS-047	4/10/03	2.23	0.73	J	91.7	2.31	J	0.46	0.05		42.5	2.52		**30.2**	3.84		2560	137	
USGS-047 Dup	4/10/03	4.81	1.59	J	106	2.68	J	0.52	0.05		42.6	2.57		**33.9**	4.96		2470	133	
USGS-048	4/10/03	3.35	1.03	J	79.6	2.19	J	0.31	0.05		76.4	3.21		**20.6**	2.96		3500	146	
USGS-051	4/2/03	0.35	0.97	UJ	5.89	0.74	J	0.20	0.03		6.36	1.93	UJ	0.08	0.13	U	10300	222	
USGS-052	4/14/03	13.2	1.78	J	196	3.46	J	0.14	0.03	J	313	6.77		7.79	1.18		3230	145	
USGS-057	4/7/03	0.59	0.77	UJ	70.3	1.69	J	0.51	0.04		51.4	2.68		**18.0**	3.08		5450	172	
USGS-067	4/7/03	3.20	1.11	J	34.1	1.48	J	0.31	0.05	J	28.1	2.32		9.53	1.57		6260	180	
USGS-085	4/9/03	1.76	0.80	UJ	10.9	0.91	J	0.17	0.03		8.55	1.93	UJ	3.56	0.62		2390	129	
USGS-112	4/9/03	5.26	1.42	J	56.5	1.90	J	-0.01	0.02	U	50.3	2.70		**14.1**	1.85		4790	156	
USGS-121	4/15/03	3.36	0.94	J	2.4	0.59	J	-0.01	0.02	U	3.29	1.82	U	-0.14	0.13	U	171	99.2	U
USGS-123	4/7/03	10.4	1.95	J	84.5	2.28	J	0.36	0.06		65.1	2.93		**23.8**	3.12		7570	191	
USGS-041 below HI interbed	7/31/03	2.06	0.33	J	18.6	0.79	J	.06	.03	U	1.76	2.21	U	**8.53**	1.38		992	110	
USGS-048 below HI interbed	8/6/03	2.65	0.93	UJ	26.6	1.63	J	.25	.05		9.58	2.81		**9.73**	1.22		2080	141	
USGS-059 below HI interbed	7/29/03	3.06	0.73	J	33.2	1.71	J	.14	.04		36.9	3.23		**9.91**	1.49		1730	127	

a. All values are in picocuries per Liter (pCi/L).

b. PCS = Primary constituent standard values from IDAPA 58.01.11.

c. FLAG = Data validation flag. A "U" indicates that an analyte was not detected. A "J" indicates an estimated value. A "UJ" indicates that the radionuclide may or may not be present, and the result is considered highly questionable. The associated value is an estimate and may be inaccurate or imprecise. The result is considered a non-detect for project data interpretation purposes.

d. The resampled results from August 11, 2003, are 70.4±8, 36.6±4.6, 21.1±2.61, and 24.2±2.61 pCi/L.

e. Bold indicates a value equal or greater than the MCL.

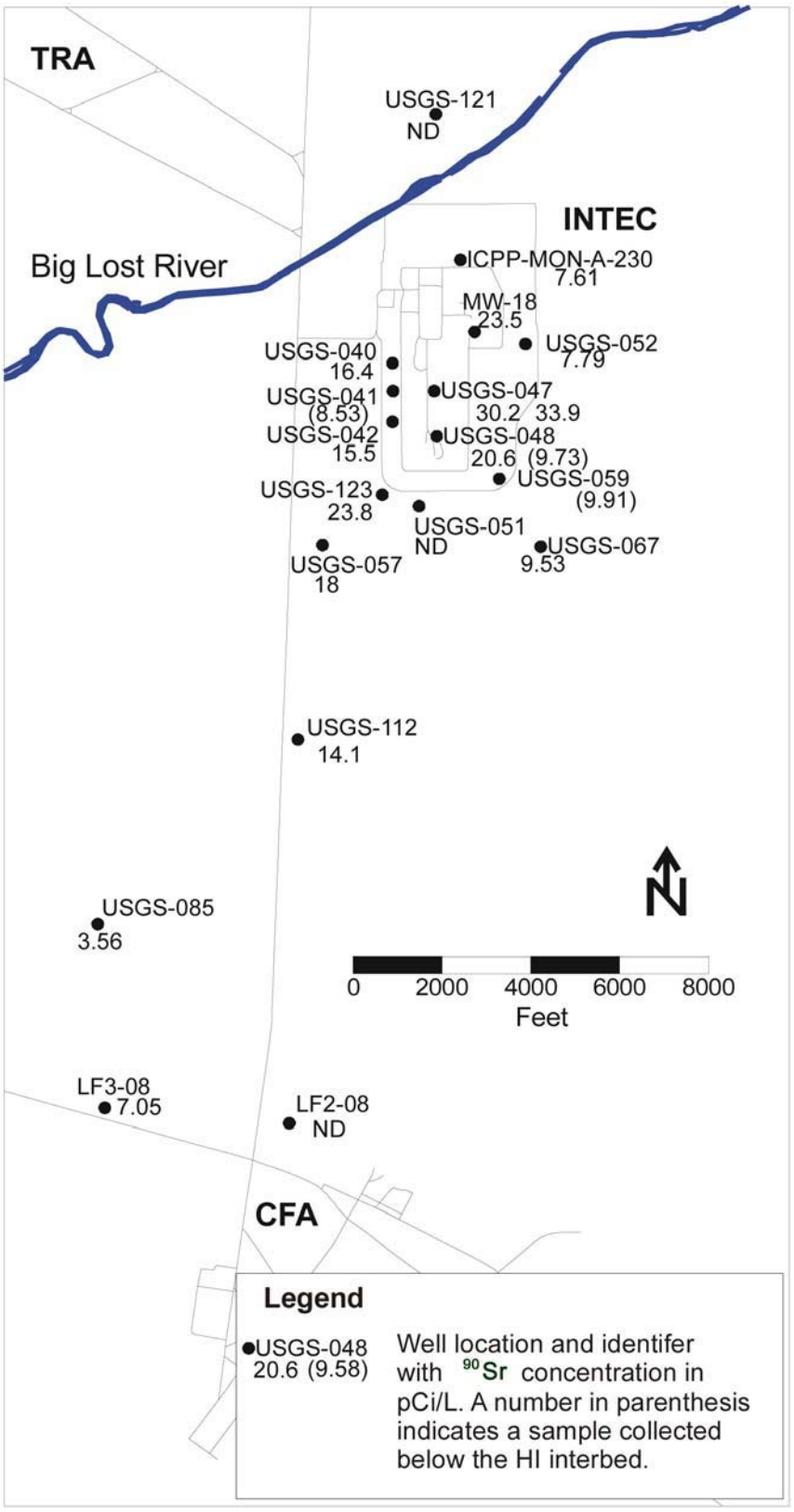

Figure 6-9. Location of INTEC monitoring wells sampled and distribution of ^{90}Sr in the SRPA in May-August 2003.

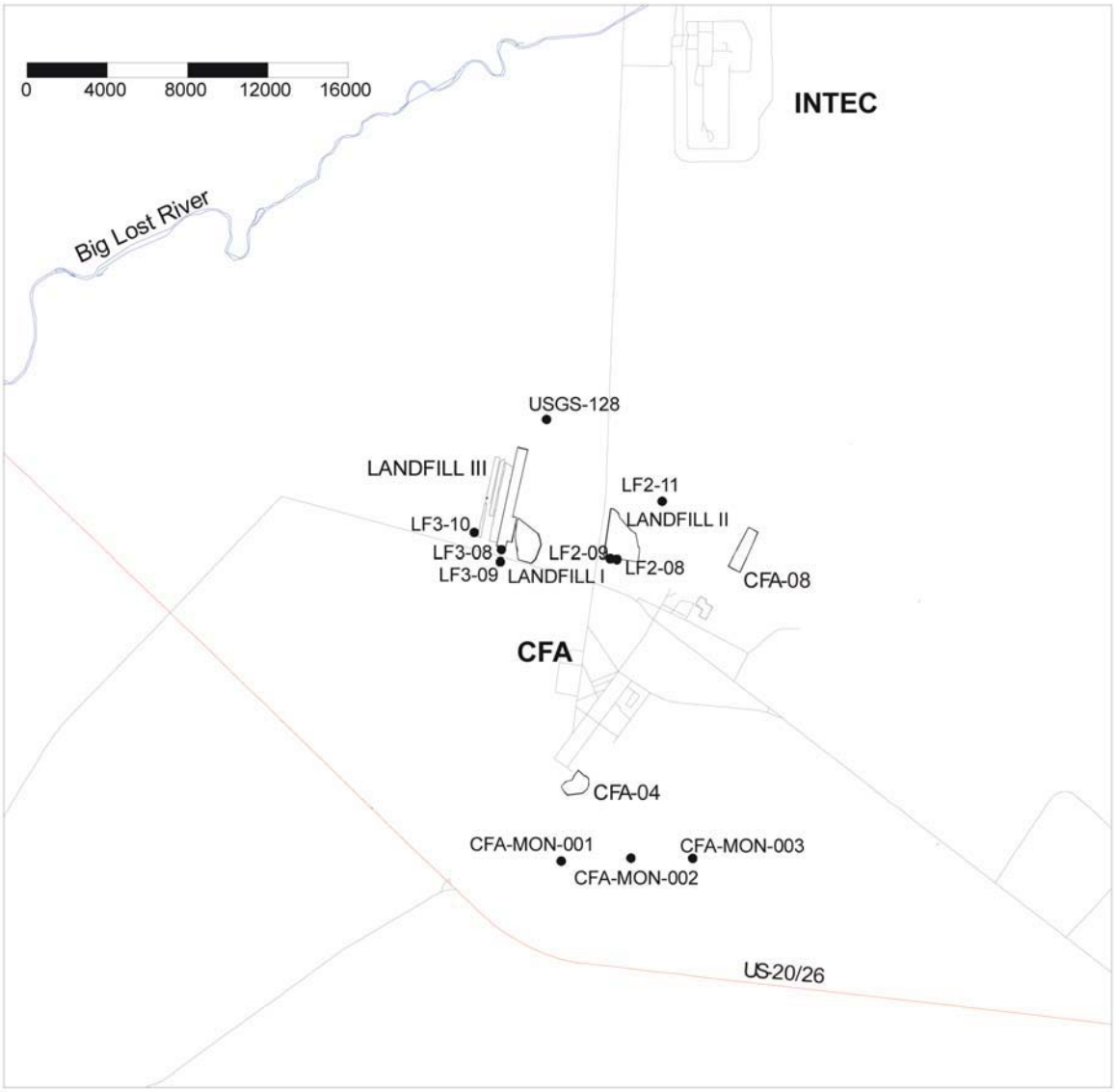

Figure 6-10. Location of WAG 4/CFA monitoring wells.

Table 6-6. WAG 4 groundwater quality summary for 2003.

Compound	Maximum Detected Value	Number of Wells with Detections above PCS[a]	PCS/SCS
Anions[b]			
Alkalinity-bicarbonate	317	NA[c]	NE[d]
Chloride[e]	117	0	250
Fluoride	0.235	0	4
Nitrate	21.3	2	10
Sulfate[e]	36.2	0	250
Organic Analytes[f]			
Toluene	32	0	1,000
Inorganic Analytes[f]			
Aluminum[e]	416	1	200
Arsenic	ND[g]	0	50
Barium	131	0	2,000
Beryllium	ND	0	4
Cadmium	ND	0	5
Chromium	42.4	0	100
Copper	ND	0	1,300
Iron[e]	1,680	2	300
Lead	ND	0	15
Manganese[e]	20.1	0	50
Mercury	ND	0	2
Nickel	112	NA	NE
Selenium	ND	0	50
Vanadium	3.4	NA	NE
Zinc[e]	958	0	5,000

a. PCS/SCS = Primary constituent standard/Secondary constituent standard values from IDAPA 58.01.11.
b. Values are in mg/L, except nitrate/nitrite which is in mg-nitrogen/L.
c. NA = not applicable.
d. NE = not established.
e. Groundwater quality secondary contaminant.
f. Organic and inorganic values are in μg/L.
g. ND = not detected.

indicated that nitrate was the only analyte above a PCS. Nitrate was detected above its PCS of 10 mg/L in wells CFA-MON-A-002 (21.3 mg/L) and CFA-MON-A-003 (11.1 mg/L). Nitrate concentrations in CFA-MON-A-002 and -003 have remained relatively steady since the wells were first sampled in 1996. Groundwater gradients and groundwater flow directions indicate that nitrate concentrations will not migrate to the CFA production wells. Nitrogen and oxygen stable isotope data were collected to evaluate the source of the nitrate. The data for nitrogen and oxygen isotope ratios in nitrate indicate a non-sewage source for the nitrate.

Iron was detected above its SCS of 300 µg/L in two samples, and aluminum was detected above its SCS of 200 µg/L in one sample. Because the pH of the groundwater is between 7 and 8 and the water has a high dissolved oxygen content, both the iron and aluminum are probably the result of suspended particulates.

Summary of WAG 5 Groundwater Monitoring Results

Groundwater monitoring at WAG 5 for 2003 was completed during October 2003 in accordance with the requirements delineated in the WAG 5 ROD (DOE-ID 2000a) and the Groundwater Monitoring Plan (DOE-ID 2000b). Nine wells are listed for sampling and the locations of these wells are shown on Figure 6-11. All the wells except ARA-MON-A-03A were sampled. Well ARA-MON-A-03A was unable to be sampled due to problems with the submersible pump. Samples were analyzed for volatile organic compounds, select metals, anions and radionuclides. Specific metals requested included arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Radionuclide analyses included gross alpha and beta, gamma spectrometry, tritium, and ^{129}I. The results are summarized below. The complete listing of results can be found in Annual Groundwater Monitoring Status Report for Waste Area Group 5 for Fiscal Year 2004 (DOE-ID 2004b).

All constituents analyzed from the October 2003 sampling event were below PCS/SCS values and/or MCLs. The data are summarized in Table 6-7. There were two detections of toluene and one detection of trichloroethylene. Toluene and trichloroethylene were detected at concentrations less than 1 µg/L and well below their respective PCSs of 1000 and 5 µg/L. Lead concentrations, which had been above its action level of 15 µg/L in several wells in the past, were all below the action level in October 2003. Replacement of galvanized pipe with stainless steel pipe appears to have removed the source of the lead in the wells. Consequently, lead concentrations have declined to background concentrations. Gross alpha and gross beta concentrations were similar to background. Cesium-134 was detected in the sample from well PBF-MON-A-001 at a concentration of 3.88 ± 0.984 pCi/L; however, the result is questionable because it is below the minimum detectable activity (MDA) of 5.26 pCi/L and no ^{137}Cs was detected in this sample. Cesium-134 is a decay product of ^{137}Cs. Iodine-129 was also detected in PBF-MON-A-001 at a concentration of 0.678 ± 0.299. This ^{129}I detection in PBF-MON-A-001 is also questionable because it is near the MDA of 0.56 pCi/L and ^{129}I previously had not been detected at this well.

Summary of WAG 7 Groundwater Monitoring Results

The RWMC at the INEEL has been used for waste disposal operations since the 1950s. The RWMC occupies about 71.6 ha (177 acres) in the southwestern quadrant of the INEEL (see Figure 3-3), and is divided into three areas: (1) the Subsurface Disposal Area (SDA), where

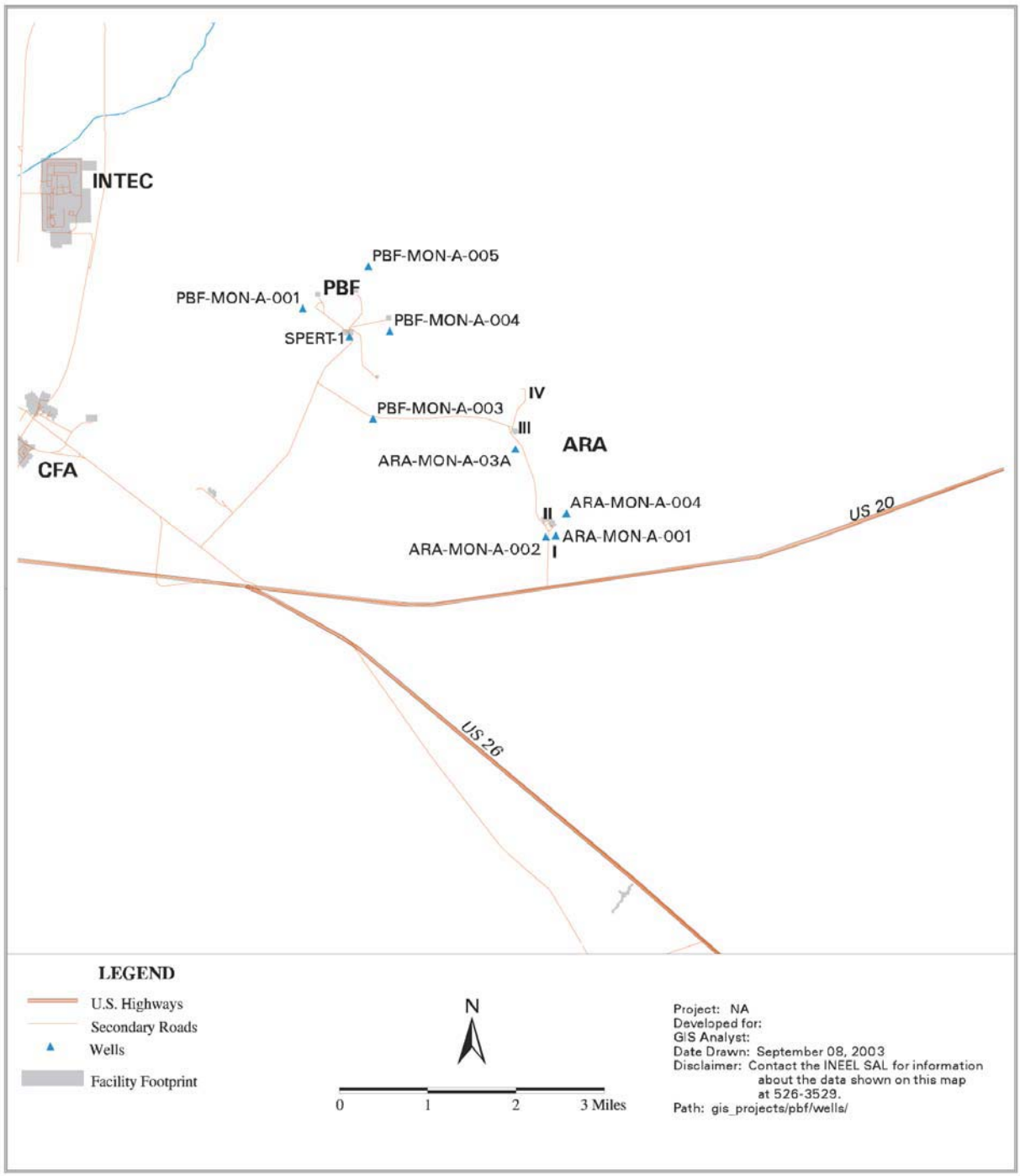

Figure 6-11. Location of WAG 5/PBF/ARA monitoring wells.

Table 6-7. WAG 5 groundwater quality summary for 2003.

Compound		Maximum Detected Value	Number of Wells with Detections above PCS[a]	PCS
Radionuclides[b]				
Gross alpha		4.13	0	15
Gross beta		4.13	0	4 mrem/yr[c]
Iodine-129		0.678	0	1[d]
Cesium-134		3.88	NA[e]	NE[f]
Organics[g]				
Toluene		0.93	0	1,000
Trichloroethene		0.44	0	5
Inorganics[g]				
Arsenic		2.68	0	50
Barium		54.1	0	2,000
Chromium		9.95	0	100
Lead		2.96	0	15
Fluoride	(mg/L)	0.546	0	4
Chloride	(mg/L)	28.4	0	250[h]
Nitrate	(mg/L)	1.1	0	10
Selenium		14.7	0	50
Sulfate	(mg/L)	25.9	0	250[h]

a. PCS = Primary constituent standard values from IDAPA 58.01.11.
b. Values are in picocuries per liter (pCi/L).
c. The primary constituent standard is an exposure as shown, however, a screening value of 50 pCi/L is commonly used.
d. Value is the EPA MCL shown for comparison only; no groundwater quality limit has been established.
e. NA = not applicable.
f. NE = not established.
g. Values are in μg/L, unless otherwise noted.
h. Groundwater quality secondary contaminant.

radioactive and hazardous wastes have been disposed of, (2) the Transuranic Storage Area, and (3) the administration and operations area. Contaminant concentrations are routinely monitored within and around the RWMC in soil gas, soil moisture, and the SRPA to determine whether waste buried in the SDA is impacting the environment. Results from these hydrologic monitoring activities are used to support the CERCLA risk assessment in the Environmental Restoration Program, and the Performance Assessment and Composite Analysis Monitoring Program in the Waste Management Program.

A total of fifteen aquifer-monitoring wells around the RWMC are sampled under Operable Unit (OU) 7-13/14 each quarter and analyzed for a variety of radionuclide, inorganic, and organic contaminants that are potential risk drivers. In addition to the wells monitored by OU 7-13/14, the USGS routinely samples eight wells in the vicinity of the RWMC. Figure 6-12 shows the location of the aquifer monitoring wells sampled in the vicinity of the RWMC.

Groundwater monitoring has been ongoing at the RWMC for more than 30 years. Currently, approximately 1300 analytes are evaluated each quarter. During these analyses, carbon tetrachloride, tritium, chromium and nitrate (as nitrogen) are consistently detected above aquifer background levels in some wells.

A total of sixty-two RWMC aquifer samples were collected by OU 7-13/14 in 2003 and analyzed for carbon tetrachloride. Thirty-three samples had detections above the quantitation limit of 1 µg/L. Of those 33 detections, seven exceeded the PCS and MCL of 5 µg/L. Besides carbon tetrachloride, four other organic compounds (i.e., trichloroethylene, 1,1,1-trichloroethane, chloroform, and toluene) were detected in RWMC groundwater samples in 2003. All sample results were below PCS/SCS values and/or MCLs. Toluene had the highest concentration (47 µg/L) in Well A11A31, followed by trichloroethylene (3 µg/L) in Wells A11A31 and M7S. The maximum chloroform concentration was 1.7 µg/L, and the maximum 1,1,1-trichloroethane concentration was 0.6 µg/L, both in the RWMC production well.

Tritium was found in about one-half of the samples collected in 2003. The maximum tritium concentration was 1690 pCi/L, which is below the aquifer PCS of 20,000 pCi/L. Even though tritium is detected in the aquifer beneath the RWMC, significant concentrations also exist upgradient of the RWMC. It is speculated that tritium at the RWMC is from upgradient facilities, primarily INTEC and TRA; however, it is also possible that the some tritium beneath the RWMC is from sources in the SDA.

Total chromium concentrations in most RWMC monitoring wells are consistent with levels typically observed around the INEEL (i.e., 1 to 22 µg/L). However, chromium concentrations in Wells M1S, M6S, M11S, and M15S are significantly above aquifer background levels and have increasing trends in concentration. Chromium levels in all RWMC aquifer wells, including the trending wells, remain below the PCS. Total chromium concentrations in 2003 ranged from 5 µg/L in Well M4D to 70 µg/L in Well M1S. Potential sources of chromium include natural sources, well construction materials, well pumps, buried waste, and upgradient facilities.

Low levels of nitrates were detected in all aquifer-monitoring wells in the vicinity of the RWMC at background concentrations typically found in the SRPA (i.e., 1 to 2 mg/L), with the exception of Well M6S. Nitrate concentrations in Well M6S are slightly above SRPA background and have a long-term trend that appears to be stabilizing at concentrations just above the SRPA background level.

Summary of WAG 9 Groundwater Monitoring Results

ANL-W samples five wells (four monitoring and one production) (Figure 6-13) twice a year for selected radionuclides, metals, total organic carbon, total organic halogens, and water quality parameters as required under the WAG-9 ROD (ANL-W 1998). Gross alpha, gross beta, and

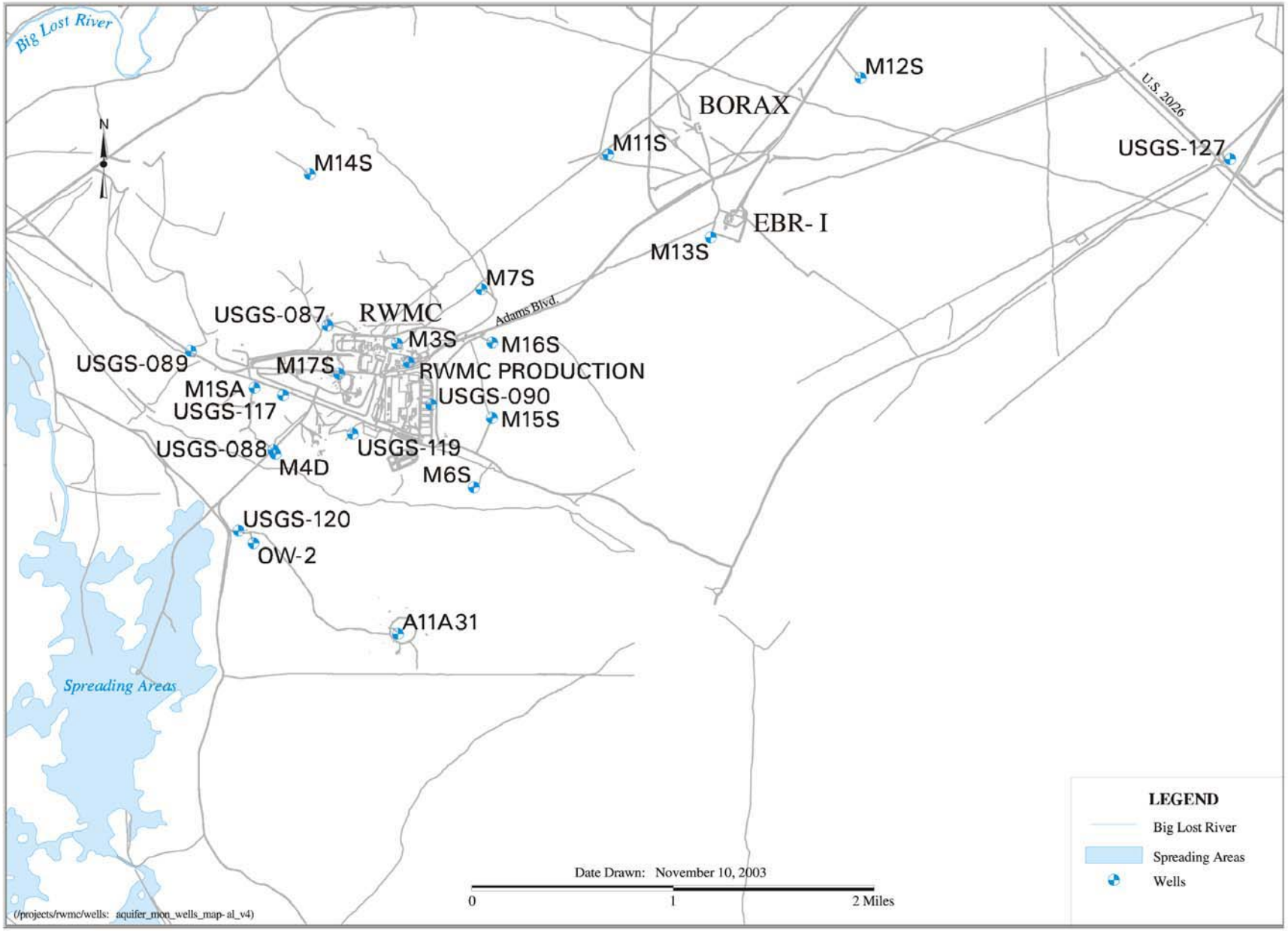

Figure 6-12. Locations of aquifer-monitoring wells at the Radioactive Waste Management Complex (WAG 7).

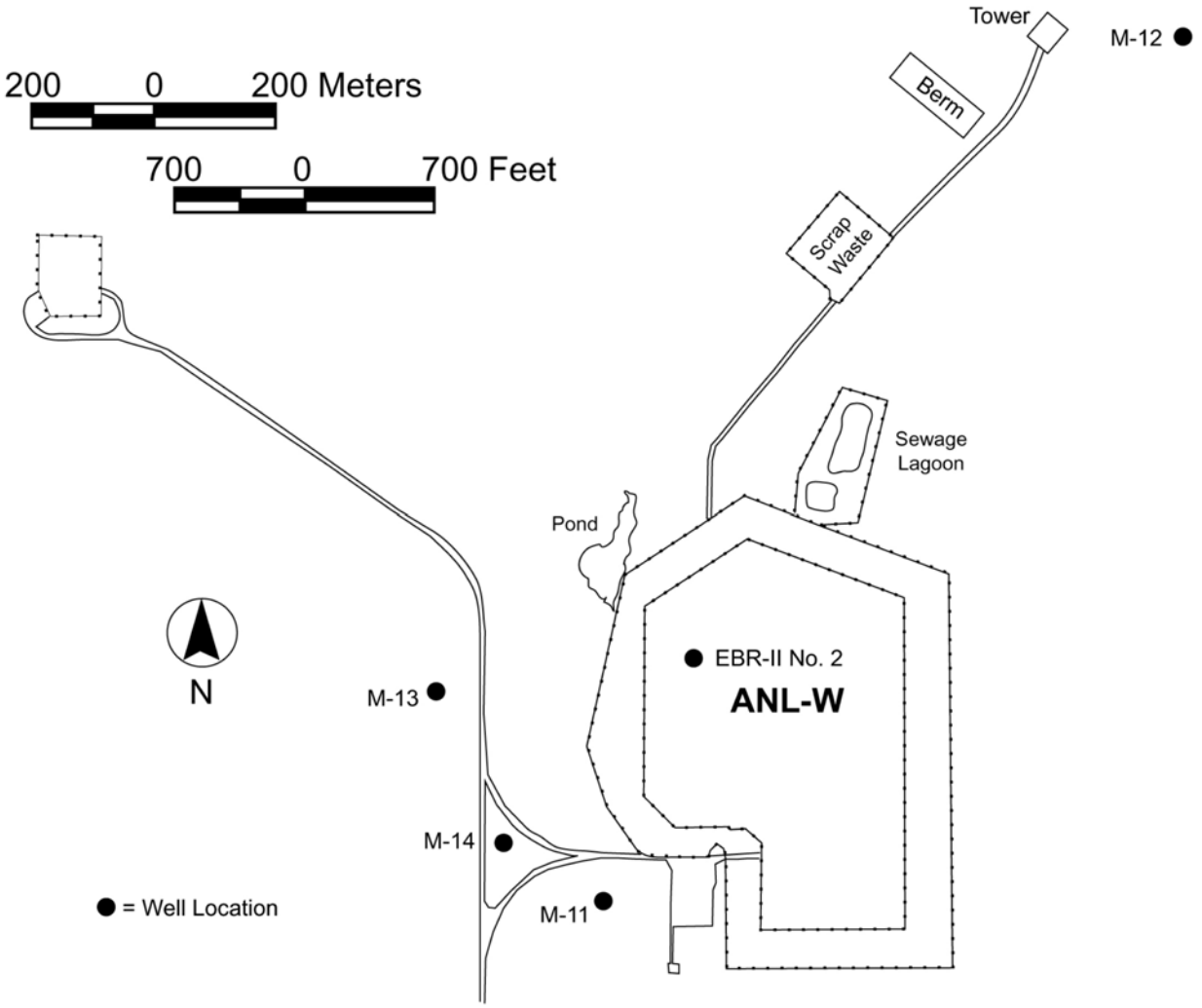

Figure 6-13. ANL-W monitoring well locations.

certain uranium isotopes were detected in groundwater during 2003. Uranium isotopes (i.e., natural uranium, uranium-235, uranium-238) and gross alpha and gross beta activity have been detected in these wells in the past. The concentrations are consistent with concentrations attributable to natural sources of uranium- and thorium-series radionuclides and the concentrations are statistically the same for both upgradient and downgradient wells, implying a natural source for this radioactivity. Table 6-8 presents the detected radionuclides for 2003.

The common metals aluminum, calcium, iron, magnesium, potassium, and sodium were detected at levels consistent with past years. Barium, chromium, copper, manganese, vanadium, and zinc also were measured (Table 6-8). Anions and water quality parameters were within ranges of past values.

Table 6-8. Summary of metals and water quality parameters in ANL-W monitoring wells (2003).

Well	M-11		M-12		M-13		M-14		EBR-II No. 2		PCS/SCS[a]
Sample Date	4/21/2003	10/7/2003	4/21/2003	10/7/2003	4/21/2003	10/7/2003	6/30/2003	10/7/2003	4/21/2003	10/7/2003	
Parameter											
Radionuclides[b]											
Gross Alpha	1.41	0.669	1.24	1.39	1.64	2.77	1.57	1.75	0.947	1.47	15
Gross Beta	1.88	2.42	2.02	2.21	1.54	2.25	3.37	1.26	2.46	3.06	50[c]
U-233/234	1.35	1.29	1.4	1.34	1.49	1.65	1.34	1.18	1.29	1.11	—[d]
U-235/236	0.0907	0.126	0.0785	0.0655	0.143	0.0734	0.105	0.107	0.0992	0.0733	NE[e]
U-238	0.81	0.644	0.515	0.569	0.687	0.525	0.682	0.577	0.598	0.599	NE
Metals[f]											
Aluminum	5.37	4.82	14.7	26.6	6.75	29.1	2.33	4.65	6.51	28.5	200
Barium	35.2	36.9	42	45.7	34.9	37.6	34	36.3	36	40.3	2,000
Calcium (x 10^4)	3.84	3.82	4.08	4.18	3.89	3.96	3.72	3.76	3.90	3.79	NE
Chromium	6.66	6.34	1.75	4	3.14	9.59	4.29	4.28	2.54	2.46	100
Copper	6.71	5.7	2.63	2.79	2.31	1.1	1.94	2.02	2.01	2.05	1,300
Iron	224	215	146	179	234	3.92	213	173	94	142	300
Lead	3.2	2.14	3.89	2.14	3.64	2.14	1.94	2.14	3.43	2.14	150
Magnesium (x 10^4)	1.36	1.29	1.30	1.22	1.34	1.33	1.17	1.19	1.31	1.23	NE
Manganese	0.653	0.76	1.44	3.01	3.48	6.97	0.529	0.76	0.354	2.37	50
Potassium (x 10^3)	3.21	8.3	4.0	3.85	3.44	3.62	3.38	3.36	3.50	3.28	NE
Sodium (x 10^4)	1.67	1.75	1.79	1.81	1.74	1.85	1.74	1.78	1.90	1.81	NE
Thallium	0.092	0.034	0.289	0.227	0.104	0.091	0.005	0.03	0.044	0.047	2
Vanadium	5.37	5.73	5.55	6.68	5.75	5.72	5.83	6.38	5.96	8.53	NE
Zinc	6.34	1.67	13.8	28.6	5.69	5.16	3.97	1.09	10.6	7.07	5,000
Anions[g]											
Chloride	19.9	19.3	0.86	0.761	18.5	18.5	19.4	18.3	19.6	19.3	250
Nitrate	1.97	2.01	1.92	1.81	1.92	1.9	1.85	1.88	1.7	1.01	10
Sulfate	16.4	16.7	1.86	0.077	17	17.2	16.9	16.5	16.1	16.7	25
Water Quality Parameters[g]											
Bicarbonate Alkalinity	118	129	121	117	143	131	145	128	144	128	NE
Carbonate Alkalinity	1.04	—[h]	1.28	—	1.38	—	1.3	—	1.42	—	NE
Total Alkalinity	119	130	122	118	145	132	146	129	146	130	NE

Table 6-8. Summary of metals and water quality parameters in ANL-W monitoring wells (2003). (continued)

Well	M-11		M-12		M-13		M-14		EBR-II No. 2		
Sample Date	4/21/2003	10/7/2003	4/21/2003	10/7/2003	4/21/2003	10/7/2003	6/30/2003	10/7/2003	4/21/2003	10/7/2003	PCS/SCS[a]
Total Dissolved Solids	235	217	214	226	227	207	279	205	239	227	500
Total Organic Carbon	1.36	2.52	1.58	2.25	1.2	2.94	0.908	1.8	0.804	1.07	NE
Total Organic Halogen	1.48	ND	0	—[i]	0	ND	1.8	ND	0.62	ND	NE
Conductivity (µS)[j]	380	364	357	350	380	361	376	365	382	365	NE

a. PCS/SCS = Primary constituent standard/Secondary constituent standard values as detailed in IDAPA 58.01.11.
b. All radionuclide values are in picocuries per liter (pCi/L).
c. The MCL for gross beta activity is four mrem/yr. A value of 50 pCi/L has been established as a screening level concentration.
d. The MCL for total uranium is a concentration (30 µg/L) instead of an activity (pCi/L).
e. NE = not established. A primary or secondary constituent standard has not yet been established for this constituent.
f. All metal values are in micrograms per liter (µg/L), unless otherwise noted.
g. All anions and water quality parameter values are in milligrams per liter (mg/L), unless otherwise noted.
h. — = carbonate alkalinity is no longer analyzed for.
i. Sample lost.
j. µS = micro-siemens.

Summary of WAG 10 Groundwater Monitoring Results

The WAG 10 groundwater sampling consisted of sampling events in March and June to July 2003. In March, eight wells were sampled for explosives, explosive degradation products, metals, anions, and radiological analytes. Explosives and explosive residues are sampled to evaluate any contamination from the time when the INEEL was used as a gunnery range and as a test site for a number of conventional explosives experiments. All results for explosives and explosive degradation products were below detection limits. The wells sampled for this event included USGS-99, USGS-17, USGS-97, USGS-76, USGS-121, Gun Range well, Highway-3, and the fire station well. A complete listing of the results for the explosives sampling in March 2003 is in Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Annual Report (FY 2003) (DOE-ID 2004c).

A second sampling event involving 22 wells occurred in June to July 2003. The wells were sampled for volatile organic compounds (the *Resource Conservation and Recovery Act* [RCRA] Appendix IX Target Analyte List), metals (filtered), anions (including bicarbonate), and radionuclides (gross alpha, gross beta, gamma spec, ^{129}I, tritium, ^{99}Tc, ^{90}Sr, and uranium-isotopes). The locations of the wells sampled in June to July are shown in Figure 6-14. The results are summarized on Table 6-9 and briefly described below. The complete results can be found in the remedial investigation annual report (DOE-ID 2004c).

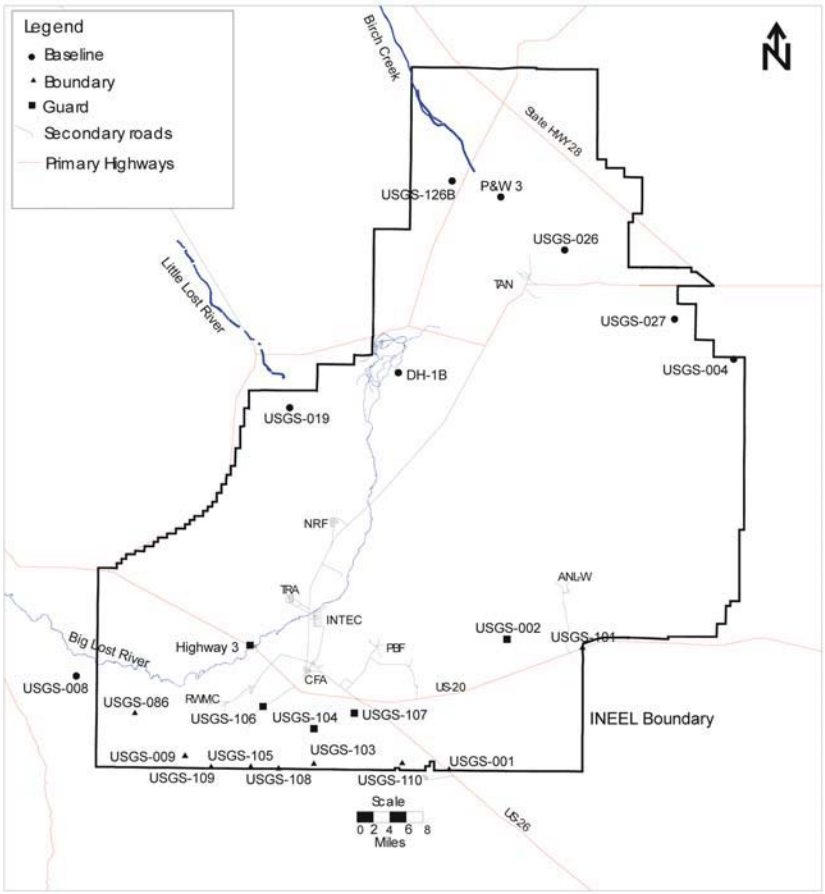

Figure 6-14. Location of monitoring wells sampled by WAG 10 in June to July 2003.

Table 6-9. WAG 10 groundwater quality summary for 2003.

Compound	Maximum Detected Value	Number of Wells with Detections above PCS[a]	PCS/SCS
Radionuclides[b]			
Gross Alpha	4.94	0	5
Gross Beta	5.68	0	4 mrem/yr
Tritium	985	0	20,000
Anions[c]			
Chloride	55.3	0	250[d]
Fluoride	0.87	0	2
Nitrate/Nitrite as N	4.6	0	10
Sulfate	39	0	250[d]
Metals[e]			
Aluminum	ND[f]	0	200[d]
Antimony	ND	0	6
Arsenic	5.2	0	50
Barium	141	0	2,000
Beryllium	ND	0	4
Cadmium	ND	0	5
Chromium	14.7	0	100
Copper	6.1	0	1,300
Iron	150	0	300[d]
Lead	10.1	0	15
Manganese	9.6	0	50[d]
Mercury	ND	0	2
Selenium	5.6	0	50
Silver	ND	NA[g]	NE[h]
Thallium	2.4	1	2
Uranium	7.9	0	30
Zinc	275	0	5,000[d]

a. PCS/SCS = Primary constituent standard/Secondary constituent standard values from IDAPA 58.01.11.
b. Values are in picocuries per liter (pCi/L).
c. Values are in milligrams per liter (mg/L), unless otherwise noted.
d. Groundwater quality secondary contaminant.
e. Values are in µg/L.
f. ND = not detected.
g. NA = not applicable.
h. NE = not established.

Thallium was the only analyte detected at or above its PCS. However, the single thallium occurrence above the PCS is at the detection limit of the analytical method employed, making this detection suspect. Nitrate is elevated in USGS-004 relative to other WAG 10 wells and probably represents off-site agricultural influences upgradient of the INEEL. Offsite influence was also indicated by elevated specific conductivity values for USGS-004 and USGS-27.

Tritium, gross alpha, gross beta, uranium isotopes were the primary radiological analytes detected. Gross alpha, gross beta, and uranium isotopes were at background concentrations. Tritium was detected in two wells at concentrations less than 1,000 pCi/L or well below the PCS of 20,000 pCi/L.

6.8 Offsite Surface Water Sampling

As part of the offsite monitoring performed by the ESER contractor, radiological analyses are performed on surface water samples taken at offsite locations. Locations outside of the INEEL boundary are sampled twice a year for gross alpha, gross beta, and tritium. In 2003, the ESER contractor collected 12 surface water samples from five offsite locations.

Gross alpha activity was detected in one surface water sample from Hagerman during 2003. The maximum concentration of 1.53 ± 0.47 pCi/L is below the PCS of 15 pCi/L and was consistent with historic concentrations. Tritium was detected in one offsite surface water sample during 2003. The November duplicate surface water sample collected in the Twin Falls area had a concentration of 94.7 ± 25.3 pCi/L (Table 6-10). This sample was well below the PCS and EPA MCL of 20,000 pCi/L and the DOE's DCG of 2.0×10^6 pCi/L for tritium in water. The EPA MCL and DOE DCG values are given for comparison purposes only and do not apply to the individual sample locations. These levels can be attributed to natural variability.

Gross beta activity was measured in nine offsite surface water samples. Detectable concentrations ranged from 3.13 ± 0.89 pCi/L to 8.01 ± 1.00 pCi/L at Buhl and Twin Falls, respectively (Table 6-10). The maximum concentration is well below the EPA screening level for gross beta in drinking water of 50 pCi/L. Concentrations in this range are consistent with those measured in the past and cannot be differentiated from natural decay products of thorium and uranium that dissolve into water as the water passes through the surrounding basalts of the Snake River Plain.

Table 6-10. 2003 ESER contractor offsite surface water results.

Location		Sample Results[a] Result ± 1s	Limits for Comparison[b] PCS[c]	EPA MCL[d]	DOE DCG[e]
Tritium					
		November 2003			
Twin Falls		94.7 ± 25.3	20,000	20,000	2,000,000
Gross Alpha					
Hagerman	(May)	1.53 ± 0.47	15	15	30[f]
Gross Beta					
		May 2003			
Bliss		5.32 ± 0.95	4 mrem/yr	50	100[g]
Buhl		4.47 ± 0.92	4 mrem/yr	50	100
Twin Falls		8.01 ±1.00	4 mrem/yr	50	100
Twin Falls	(duplicate)	5.38 ± 0.97	4 mrem/yr	50	100
		November 2003			
Bliss		4.89 ± 0.97	4 mrem/yr	50	100
Buhl		3.13 ± 0.89	4 mrem/yr	50	100
Hagerman		4.55 ± 0.91	4 mrem/yr	50	100
Twin Falls		7.14 ± 1.05	4 mrem/yr	50	100
Twin Falls	(duplicate)	7.47 ± 1.05	4 mrem/yr	50	100

a All values shown are in picocuries per liter (pCi/L), plus or minus one standard deviations (± 1s) unless otherwise noted. **Only detected measurements are reported.**

b. Values shown are in picocuries per liter (pCi/L), unless otherwise noted. These limits are shown for comparison purposes only and do not apply to the surface water samples.

c. PCS = Primary constituent standard values from IDAPA 58.01.11.

d. MCL = maximum contaminant level

e. DCG = Derived Concentration Guide.

f. Value based on the most conservative alpha emitter (^{241}Am).

g. Value based on the most conservative beta emitter (Radon-226).

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